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Technical Memorandum Post-Interim Construction Risk Assessment for Site 3 – Causeway Landfill

Marine Corps Recruit Depot Parris Island, South Carolina

Contract Task Order 0164

July 2010

NAVFAC Naval Facilities Engineering Command
NAVFAC SOUTHEAST
NAS Jacksonville
Jacksonville, Florida 32212-0030

TETRA TECH NUS, Inc.

REVISION 2
JULY 2010

TECHNICAL MEMORANDUM
POST-INTERIM CONSTRUCTION RISK ASSESSMENT
SITE 3 – CAUSEWAY LANDFILL

MARINE CORPS RECRUIT DEPOT
PARRIS ISLAND, SOUTH CAROLINA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
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Southeast
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Submitted by:
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ATSDR	Agency for Toxic Substances and Disease Registry
AWQC	Ambient Water Quality Criteria
BAP	Benzo(a)pyrene
BSAF	Biota-sediment accumulation factors
BTAG	Biological Technical Assistance Group
Cal EPA	California Environmental Protection Agency
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CMS	Corrective Measure Study
CNS	Central Nervous System
COC	Contaminant of concern
COPC	Chemical of potential concern
cPAH	Carcinogenic polynuclear aromatic hydrocarbons
CSF	Cancer slope factor
ED	Exposure duration
EF	Exposure frequency
EPC	Exposure Point Concentration
ERA	Ecological risk assessment
ESI	Extended Site Inspection
ESV	Ecological screening value
FS	Feasibility Study
GS	Gastrointestinal
HEAST	Health Effects Assessment Summary Tables
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
IAS	Initial Assessment Study
ILCR	Incremental lifetime cancer risk
IR	Ingestion rate
IRA	Interim Response Action
IRIS	Integrated Risk Information System
KAS	Katahdin Analytical Services
KM	Kaplan-Meier
MCRD	Marine Corps Recruit Depot
MDL	Method detection limits
MRL	Minimal Risk Level

NCEA	National Center for Environmental Assessment
NEESA	Naval Energy and Environmental Support Activity
NOAA	National Oceanic and Atmospheric Administration
NOAEL	No-observed-adverse-effects-level
ORNL	Oak Ridge National Laboratory
OSWER	Office of Solid Waste and Emergency Response
PAH	Polynuclear aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PEL	Probable Effects Level
PPRTV	Provisional Peer Reviewed Toxicity Values
RAGS	Risk Assessment Guidance for Superfund
RBC	Risk-Based Concentration
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RfD	Reference dose
RFI	RCRA Facility Investigation
RI	Remedial Investigation
ROD	Record of Decision
RSV	Recommended Screening Values
SGS	SGS North America, Inc.
SMDP	Scientific/management decision points
SVOC	Semivolatile organic compound
TDS	Total dissolved solids
TEF	Toxicity equivalency factor
TEL	Threshold Effects Level
TEQ	Toxic equivalent contentration
TOC	Total organic carbon
TtNUS	Tetra Tech NUS, Inc.
U.S. EPA	United States Environmental Protection Agency
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
VOC	Volatile organic compound
VS	Verification Step

TECHNICAL MEMORANDUM
POST-INTERIM CONSTRUCTION RISK ASSESSMENT
SITE 3 – CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

1.0 OBJECTIVE

This Technical Memorandum presents the results of the post-interim construction risk assessment(s) performed on sediment and fish tissue at Site 3. Re-characterization of sediment at Site 3 is a provision of the Interim Soil Record of Decision (ROD) [Tetra Tech NUS, Inc. (TtNUS), September 2000]. Uncertainty about the representativeness of sediment uptake models in accurately estimating the human receptor exposures required that the focus of this Technical Memorandum include both sediment and fish tissue data collected after implementation of the Interim Response Action (IRA) identified in the Interim ROD. The sediment data included in the risk assessment(s)/sediment re-characterization were collected in October 2001 by TtNUS and April 2003 by the United States Environmental Protection Agency (U.S. EPA). The fish tissue data included in the Human Health Risk Assessment (HHRA) were collected in October 2009 by TtNUS. The results of both the human health and ecological risk assessments conducted using these data are presented in this Technical Memorandum.

2.0 BACKGROUND

Site 3 (Causeway Landfill) is located in the northwestern portion of Marine Corps Recruit Depot (MCRD) Parris Island and is an integral part of a causeway that connects Horse Island and Parris Island. Site 3 was used as the major disposal area for trash and other materials between 1960 and 1972. The solid waste disposed at the site reportedly included empty pesticide containers, oily rags, spent absorbent, petroleum and chlorinated solvent sludge, tetrachloroethene still bottoms, mercury amalgam and beryllium waste, polychlorinated biphenyl (PCB)-contaminated oil, and metal shavings. The causeway was constructed across a tidal marsh of the Broad River by filling in the marsh. When landfilling at the site was discontinued in 1972, the causeway covered approximately 10 acres and was 4,000 feet long, 100 feet wide, and 10 feet high (above the water surface). The causeway currently separates a ponded area (north of the causeway) from a marshy area (south of the causeway).

Site 3 consists of the original landfill, the causeway constructed over the landfill, and sediments within 200 feet of the northeastern side of the causeway (within the 3rd Battalion Pond). The causeway currently separates the 3rd Battalion Pond (north of the causeway) from a marshy area (south of the causeway). The 3rd Battalion Pond is essentially open water with scattered areas of cordgrass and occasionally receives tidal inflow via two sets of culverts beneath the causeway. The marshy area south of the causeway is a vast expanse of thickly vegetated cordgrass intersected by several tidal channels.

2.1 Previous Investigations

Environmental investigations of Site 3 began in 1986. The following section provides a brief overview of the investigations conducted at Site 3.

2.1.1 Initial Assessment Study

An Initial Assessment Study (IAS) was conducted in 1986 by the Naval Energy and Environmental Support Activity (NEESA) to identify potentially contaminated sites at MCRD Parris Island. The IAS identified Site 3 as a site requiring further investigation to assess potential long-term impacts to human health and the environment and recommended that a Verification Step (VS) investigation be conducted at Site 3 (NEESA, September 1986).

2.1.2 Verification Step

Based on recommendations presented in the IAS, eight shallow soil/sediment samples (SS-1 through SS-8) and eight surface water samples were collected in 1988 along the edges of the causeway and analyzed for priority pollutants as part of the VS at Site 3 (McClelland Consultants, May 1990). No organic compounds were detected in sediment or surface water, but cadmium, lead, and mercury were elevated in some surface water and sediment samples. Table 1 provides a summary of the 1988 sediment sample results and a comparison of the sample results to human health and ecological screening values (ESVs) that were current at the time of the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI)/Remedial Investigation (RI) Report (TtNUS, November 1999). These sediment samples contained elevated concentrations (above screening criteria) of mercury. The VS concluded that additional sampling of surface water and sediment was needed (McClelland Consultants, May 1990).

2.1.3 Interim RCRA Facility Assessment

Per the requirements of the MCRD's application for a RCRA permit, an Interim RCRA Facilities Assessment (RFA) was performed in 1990. The RFA indicated that there was documented disposal of wastes containing hazardous constituents in an unlined unit in the immediate vicinity of surface waters and that a RFI was necessary for Site 3 (A.T. Kearney, Inc., April 1990).

2.1.4 Extended Site Inspection

An Extended Site Inspection (ESI) was conducted to evaluate whether the consumption of fish and shellfish caught by recreational fishermen in the vicinity of Site 3 posed a risk to human health (ABB Environmental Services, Inc., August 1993). Samples of fish and shellfish commonly harvested in the area were collected from both sides of the causeway in 1991 and analyzed for polycyclic aromatic hydrocarbons (PAHs), PCBs, pesticides, and mercury. The sample results indicated that elevated concentrations of pesticides and PCBs existed in some samples from the pond side of the causeway. The fish tissue analytical results were evaluated in the human health and ecological risk assessments performed as part of the RFI/RI report prepared in 1999 (see Section 2.1.5).

2.1.5 RCRA Facilities Investigation/Remedial Investigation

An RFI/RI, encompassing both RCRA and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requirements, was conducted in 1998 and 1999 (TtNUS, November 1999). The RFI/RI field investigation was conducted from May 1998 to September 1998 and included sampling and analyses of 16 surface soil samples, 5 subsurface soil samples, 20 surface water samples, 21 sediment samples, and 4 groundwater samples. The field investigation also included a tidal study and aquifer tests and the establishment of background concentrations. Twelve additional sediment samples were collected in August 1999 to better delineate contamination found in the earlier sediment samples. The surface soil, sediment, groundwater, and surface water data were used in the preparation of human health and ecological risk assessments for the RFI/RI. Table 2 provides a summary of Human Health Cancer Risks and Hazard Indices (HIs) as reported in the RFI/RI (TtNUS, November 1999).

2.1.5.1 Summary of Site Risks – Soil

As shown in Table 2, the results of the HHRA indicated that direct exposure to soil (incidental ingestion and dermal contact) by construction workers and maintenance workers resulted in acceptable risks for both receptors. The results of the ecological risk assessment indicated that pesticides, PCBs, PAHs, and several metals in soil may pose risks to benthic (soil) invertebrates. The results also indicated that metals and PCBs may pose risks to upper-level receptors such as birds and mammals. The RFI/RI recommended that a Feasibility Study (FS) or Corrective Measures Study (CMS) be conducted to evaluate capping/covering options for the landfill to protect ecological receptors from exposure to soil and to prevent erosion of soil into the sediment.

2.1.5.2 Summary of Site Risks – Groundwater

The results of the HHRA (Table 2) indicated that direct exposure to groundwater (dermal contact) by construction workers resulted in acceptable risks for this receptor. This was the only human health exposure scenario for groundwater evaluated in the RFI/RI because groundwater is not currently used as a potable water supply at the site nor is it expected to be used in the future as a potable water supply for the following reasons (as identified in the Site 3 RFI/RI):

- The configuration of the site (5,000 feet long, 100 feet wide, with a 20-foot road running down the middle) and the location of underground utilities along the sides of the road preclude the installation of potable supply wells at Site 3.

- Total dissolved solids (TDS) present in groundwater averaged 10,050 mg/L in the four groundwater samples collected in 1998. According to the State of South Carolina, groundwater that exceeds a concentration of 10,000 mg/L TDS can be classified as Class GC (groundwater not considered potential sources of drinking water). Attempts to pump water from this area (with salt-water pond on one side of the causeway and a salt-water marsh on the other side of the causeway, and a limited precipitation infiltration area) would be more likely to draw water from these salt-water bodies and not from accumulated precipitation infiltration.

- The site is a landfill and under future scenarios considered for the causeway, restrictions would be placed to prevent installation of wells for potable water use.

The ecological risk assessment performed for the Site 3 RFI/RI included the comparison of groundwater contaminant concentrations to surface water ESVs to determine if potential risks to aquatic biota may be possible via discharge of contaminated groundwater to surface water. Since dilution will occur upon discharge, groundwater concentrations must, for the most part, significantly exceed surface water ESVs to be of concern. The maximum concentration of only one groundwater contaminant, chlorobenzene (130 µg/L), slightly exceeded its surface water ESV (105 µg/L) and it was not detected in surrounding surface water or sediment samples. Consequently groundwater does not present a threat to surrounding surface water and sediment. However, long-term monitoring of groundwater was identified as a provision of the Interim ROD signed in September 2000.

2.1.5.3 Summary of Site Risks – Surface Water

Review of the RFI/RI surface water data indicates that exposure to surface water does not present risks to human health and the environment that warrant remediation of the surface water.

Human Health

During the HHRA conducted for the Site 3 RFI/RI, the following chemicals detected in surface water were identified as chemicals of potential concern (COPCs):

- benzo(a)anthracene; benzo(a)pyrene (BAP); benzo(b)fluoranthene; benzo(k)fluoranthene; chrysene; indeno(1,2,3-cd)pyrene [all carcinogenic PAHs (cPAHs) were retained as COPCs and were evaluated in the HHRA as BAP equivalents)
- bis(2-ethylhexyl)phthalate
- aluminum
- arsenic (filtered samples only)
- iron
- manganese

These chemicals were identified as COPCs because the maximum concentration exceeded the Screening Toxicity Values (National Water Quality Criteria – Human Health – Consumption of Organisms and Water) available at the time of the RFI/RI [Region III Drinking Water Risk-Based Concentrations (RBCs) were used if Water Quality Criteria were not available]. Although concentrations of lead, mercury, and vanadium exceeded the Screening Toxicity Values, these chemicals were not retained as COPCs because they were detected infrequently in the surface water samples (1 of 20 samples).

The COPCs were carried through the HHRA and risks to construction workers via exposure to surface water (incidental ingestion and dermal contact) were calculated. Risks to recreational users and maintenance workers from exposure to surface water were not calculated because of the presence of alligators in the area (warnings are posted on the causeway prohibiting swimming/wading in the surface water adjacent to the causeway).

As shown in Table 2, all estimated cancer risks for construction workers (including exposure to surface water) were within U.S. EPA's target risk range of 1E-04 to 1E-06 (the estimated cancer risk for construction workers exposed to surface water was 1.0E-05). In addition, all estimated hazard indices (HIs) for construction workers were less than the acceptable level of 1.0, indicting that adverse health effects are not anticipated for construction workers (the estimated HI for construction workers exposed to surface water was 0.14). Risks for construction workers exposed to surface water would be lower if risks were re-calculated using current HHRA guidance.

Consequently, exposure of construction workers to surface water does not result in unacceptable risks and remediation of the surface water is not needed for protection of human health.

Ecological

During the ecological risk assessment (ERA) conducted for the Site 3 RFI/RI, the following chemicals detected in surface water were identified as COPCs because the maximum surface water concentrations exceeded U.S. EPA Region IV ESVs:

- fluoranthene
- arsenic, chromium, copper, lead, mercury, nickel, zinc (unfiltered samples only)
- silver (both filtered and unfiltered samples)

The following chemicals detected in surface water were identified as COPCs because ESVs did not exist for them:

- acetone
- benzo(a)anthracene; BAP; benzo(b)fluoranthene; benzo(g,h,i)perylene; benzo(k)fluoranthene; chrysene; indeno(1,2,3-cd)pyrene; and pyrene
- bis(2-ethylhexyl)phthalate
- beryllium, cobalt (unfiltered samples only)
- aluminum, antimony, barium, iron, manganese, vanadium (both filtered and unfiltered samples)

Based on the aquatic food chain modeling using sediment and surface water data, the following chemicals detected in surface water had at least one hazard quotient (HQ) greater than 1.0 using maximum and mean concentrations:

- aluminum, arsenic, iron, lead, mercury, vanadium

The following chemicals detected in surface water had at least one food chain modeling HQ greater than 1.0 using maximum concentrations but none greater than 1.0 using mean concentrations:

- barium, cobalt, zinc

Refinement of COPCs was incorporated into the Site 3 ERA. This refinement involved the consideration of factors such as background data, toxicological evaluation of COPCs, frequency of detection, and comparisons of COPCs to alternate guidelines. The following text is a synopsis of information contained in the RFI/RI.

Acetone was the only volatile organic compound (VOC) detected in surface water and it was detected in only one sample. In addition, the concentration (3 µg/L) does not appear to be high, acetone is a common laboratory contaminant, and in general, VOCs do not bioaccumulate or biomagnify. Consequently, acetone poses negligible risks to aquatic receptors (e.g., fish and aquatic invertebrates) and upper level receptors (raccoon, heron, mummichug, red drum, and eagle).

Ten semivolatile organic compounds (SVOCs) were identified as COPCs in surface water and all but one of them was identified because there were no Region IV ESVs available. The maximum concentration of the one SVOC that did have an ESV (fluoranthene) only slightly exceeded the ESV (HQ=1.2). Most of the SVOCs were detected infrequently in surface water (only 1 to 3 detections out of 20 samples). The most frequently detected SVOC [bis(2-ethylhexyl)phthalate – 6 of 20 samples] had a maximum concentration of 7 µg/L, which was much less than the U.S. EPA Region III Biological Technical Assistance Group (BTAG) ESV of 360 µg/L available at the time (current Region III BTAG ESV is 16 µg/L for freshwater – there is none for salt water). None of the SVOCs had HQ values greater than 1.0 in the food chain modeling. Consequently, SVOCs pose negligible risks to aquatic receptors and upper level receptors.

Eight metals were retained as surface water COPCs because the maximum concentrations of the unfiltered samples or the filtered samples exceeded Region IV ESVs (arsenic, chromium, copper, lead, mercury, nickel, silver, and zinc). Of these eight metals, lead, mercury, and nickel were detected only once in the unfiltered samples (out of 20 samples) and were not detected in the filtered samples. Chromium was detected in three of the unfiltered samples and was not detected in the filtered samples. As discussed by U.S. EPA (1996), concentrations of dissolved metals, rather than total metals, more closely approximate the bioavailable fraction of metals in the water column. In addition, only the maximum concentrations of these chemicals detected in the unfiltered samples exceeded the Region IV ESVs. Consequently, chromium, lead, mercury, and nickel pose negligible risks to aquatic receptors and upper level receptors.

Arsenic was detected in only 1 of 20 unfiltered samples and 2 of 20 filtered samples. The single unfiltered detection was the only detection with a concentration that exceeded the background concentration for arsenic and the Region IV ESV (neither concentration detected in the filtered samples exceeded the Region IV ESV). As noted above, concentrations of dissolved metals, rather than total metals, more closely approximate the bioavailable fraction of metals in the water column. Consequently, arsenic poses negligible risks to aquatic receptors and upper level receptors.

Copper was detected in 8 of the 20 unfiltered samples and 3 of the 20 filtered samples. Only the concentrations detected in four unfiltered samples exceeded the Region IV ESV (2.9 µg/L) and only the concentrations in two unfiltered samples exceeded the background concentration for copper (7 µg/L). The concentrations of copper in the filtered samples did not exceed the background concentration or the Region

IV ESV. In addition, copper did not result in any HQ values greater than 1.0 in the food chain modeling. Consequently, copper poses negligible risks to aquatic receptors and upper level receptors.

Silver was detected in only 4 of 20 unfiltered samples and in only 1 of 20 filtered samples. All detections of silver did exceed the Region IV ESV for silver (0.23 µg/L). However, since silver was detected in only one of the filtered samples, silver does not appear to present significant risks to aquatic receptors and upper level receptors.

Zinc was detected in only 4 of 20 unfiltered samples, but was detected in 18 of 20 filtered samples. Only the maximum concentration in the unfiltered samples exceeded the Region IV ESV (86 µg/L) and only the maximum concentration resulted in HQ values greater than 1.0 in the food chain modeling. Consequently, zinc poses negligible risks to aquatic receptors and upper level receptors.

Eight metals were retained as ecological COPCs because there were no Region IV ESVs for them (aluminum, antimony, barium, beryllium, cobalt, iron, manganese, and vanadium).

Of these eight metals, beryllium and cobalt were detected only once in the unfiltered samples (out of 20 samples) and were not detected in the filtered samples. As noted above, concentrations of dissolved metals, rather than total metals, more closely approximate the bioavailable fraction of metals in the water column. Consequently, beryllium and cobalt pose negligible risks to aquatic receptors and upper level receptors.

Aluminum was detected in 18 of 20 unfiltered samples, but in only 2 of 20 filtered samples. The concentration of aluminum in only two of the unfiltered samples exceeded the background concentration of 3,100 µg/L. Consequently, aluminum poses negligible risks to aquatic receptors and upper level receptors.

Since antimony was detected in only 4 of the 20 samples (both filtered and unfiltered), the concentrations were relatively low (less than 4.2 µg/L), and there are no Region IV ESVs, antimony does not appear to pose significant risks to aquatic receptors and upper level receptors.

Barium was detected in 13 of 20 unfiltered samples and all 20 filtered samples. Only three of the filtered concentrations and two of the unfiltered concentrations exceeded the background concentrations (unfiltered and filtered) for barium. Only the maximum surface water and sediment concentrations of barium resulted in an HQ value greater than 1.0 in the food chain modeling [Raccoon no-observed-adverse-effects-level (NOAEL) – 2.27]. Consequently, barium poses negligible risks to aquatic receptors and upper level receptors.

Iron was detected in 18 of 20 unfiltered samples and only 2 of 20 filtered samples. The concentrations detected in the two filtered samples (175 and 549 µg/L) are less than the background concentration for iron (2090 µg/L). Consequently, iron poses negligible risks to aquatic receptors and upper level receptors.

Manganese was detected in 19 of 20 unfiltered samples and 15 of 20 filtered samples. Manganese did not result in any HQ values greater than 1.0 in the food chain modeling. Consequently, manganese poses negligible risks to upper level receptors.

Furthermore, marine surface water screening values for manganese were not available, but the Tier II chronic screening value reported by National Oceanic and Atmospheric Administration (NOAA) is 120 µg/L for manganese in freshwater surface water (Buchman, 1999). Tier II values are developed so that aquatic benchmarks can be derived with fewer data than are required for ambient water quality criteria (AWQC) values, and Tier II values are developed using methodology described by U.S. EPA (1993). Tier II values are commonly used as screening values in ecological risk assessments. Although there is uncertainty involved in using freshwater benchmarks for marine surface water, freshwater benchmarks can be used in marine surface water risk assessments (U.S. EPA 1993). Manganese concentrations in filtered surface water samples at Site 3 ranged from 7.4 to 156 µg/L, and concentrations exceeded the 120 µg/L Tier II value in only 2 filtered samples, with a maximum HQ of 1.3. Therefore, manganese poses negligible risks to aquatic receptors.

Vanadium was only detected in 1 of 20 unfiltered samples and 1 of 20 filtered samples. Only the maximum unfiltered concentration exceeded the background concentration for vanadium. Consequently, vanadium poses negligible risks to aquatic receptors and upper level receptors.

In summary, the contaminants detected in surface water pose negligible risks to bethnic receptors and upper level receptors for the following reasons:

- Contaminant detected infrequently in surface water samples and generally does not bioaccumulate or biomagnify - acetone.

- Contaminant detected infrequently in surface water samples, does not have a Region IV ESV, and did not result in HQ values greater than 1.0 in the food chain modeling - SVOCs.

- Contaminant was detected infrequently in unfiltered surface water samples and was not detected in filtered surface water samples (which more closely approximate the bioavailable fraction of metals in surface water) – beryllium, chromium, cobalt, lead, mercury, and nickel.

- Contaminant was detected infrequently in surface water samples and only the maximum concentration exceeded background concentrations or the Region IV ESV – aluminum, arsenic, vanadium, and zinc.

- Contaminant was detected infrequently in the filtered samples and the concentrations did not exceed the background concentration or the Region IV ESV – copper.

- Contaminant was detected infrequently in the filtered samples – antimony and silver.

- Contaminant does not have a Region IV ESV and was detected at concentrations that, with the exception of the maximum concentration, did not result in HQ values greater than 1.0 in the food chain modeling – barium.

- Contaminant does not have a Region IV ESV, was detected infrequently in the filtered samples at concentrations less than background concentrations – iron.

- Contaminant does not have a Region IV ESV, but was detected in only 2 filtered samples at concentrations greater than a Tier II chronic screening value and did not result in any HQ values greater than 1.0 in the food chain modeling – manganese.

In addition, chemical concentrations in surface water at Site 3 depend on several factors, and will vary in relation to the amount of tidal influence at any given time. For example, tides can bring in chemicals from other areas. Tides and tidal movement can also influence the physical chemistry of the surface water, thereby potentially altering the bioavailability of surface water contaminants. Tidal movement can increase the amount of suspended particulates, which can bind to analytes in solution and reduce their bioavailability. The amount of groundwater discharge can also influence the concentrations of analytes in surface water. If the surface water samples were collected at seeps, representative concentrations may be overestimated if groundwater is contaminated or vice versa at seeps with little contamination. For these reasons, surface water is not always the best indicator of potential contaminant release and environmental conditions in dynamic systems such as the marsh adjacent to Site 3. Sediments, however, integrate pollutants over time and often indicate a history of contamination to a greater extent than surface water.

In summary, the evaluation of surface water samples collected during the RFI/RI investigation indicated that ecological risks posed by surface water COPCs were negligible and remediation of the surface water is not needed for protection of ecological receptors. The MCRD Parris Island Partnering Team has concurred on this finding.

2.1.5.4 Summary of Site Risks – Sediment

A total of 21 sediment samples were collected during the RFI/RI (PAI-03-SD-09 through PAI-03-SD-28). Sample locations are shown on Figure 1. Table 3 provides a summary of the 1998 sediment sample results and also provides a comparison of sample results to the human health and ESVs used during preparation of the RFI/RI Report (TtNUS, November 1999). Concentrations of several PAHs, aluminum, arsenic, iron, and vanadium exceeded the human health screening levels. PAHs, pesticides (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-chlordane, and gamma-chlordane), PCBs (Aroclor-1254 and Aroclor-1260), arsenic, copper, lead, mercury, and zinc concentrations exceeded ecological screening levels.

As shown in Table 2, the results of the HHRA indicated that direct exposure to the sediments (incidental ingestion and dermal contact) by construction workers and maintenance workers resulted in acceptable risks for both receptors. The HHRA did indicate that consumption of fish (using sediment concentrations to calculate fish tissue concentrations) resulted in unacceptable carcinogenic and non-carcinogenic risks. Pesticides, cPAHs, and arsenic were the main contributors to the cancer risk, and PCBs, arsenic, and mercury were the main contributors to the non-cancer risks. Risks were also calculated using actual fish tissue concentrations from the fish samples collected in 1991 during the ESI. The risks based on exposure to the actual fish tissue concentrations were acceptable for an occasional consumer (one meal per week), but non-carcinogenic risks for a frequent consumer (one meal per day) were unacceptable (Aroclor-1254).

Direct contact with sediment by recreational users was not evaluated in the Site 3 RFI/RI HHRA because the sides of the causeway are steep making direct contact with surface water and sediment difficult. In addition, warnings are posted on the causeway prohibiting swimming/wading in the surface water adjacent to the causeway because of the presence of alligators in the area. The recreational user fishing scenario was evaluated because of the presence of fishing platforms at the site and because recreational fishing is known to occur there.

The results of the ecological risk assessment indicated that pesticides, PCBs, PAHs, and several metals in sediment may pose risks to benthic (sediment) invertebrates. The results also indicated that metals and 4,4'-DDT and its metabolites 4,4'-DDD and 4,4'-DDE may pose risks to upper-level receptors such as birds, mammals, and fish. However, concentrations of 4,4'-DDT and its metabolites and most metals were similar to background/typical facility pesticide concentrations in sediment (as defined in the RFI/RI). The RFI/RI recommended that, even though the data do not suggest the presence of significant widespread sediment contamination, potential contamination at some locations should be evaluated. Potential ecological risks were associated with direct contact with soil/waste/sediment and the potential for erosion of contaminated material into the sediment.

Twelve additional sediment samples (PAI-03-SD-29 through PAI-03-SD-40) were collected in 1999 to better define the distribution of sediment contamination. Sample locations are shown on Figure 2, and Table 4 provides a summary of the 1999 sediment data. Comparison of these data with the 1998 data (Table 3) indicates that only 4,4'-DDE was detected at a higher concentration in the 1999 samples than in the 1998 samples. The highest concentrations of each of the site contaminants were detected along the toe of the landfill and generally corresponded to areas where eroded waste was visible.

Four areas of sediment on the pond side of the causeway were identified as representing potentially significant risks that warranted remedial action (sediments on the marsh side did not present risks that warranted remedial action). These areas were identified as Areas 1, 2, 3, and 4 (Figure 3), and the following COCs were identified for each area:

- Area 1: PAHs [anthracene, benzo(a)anthracene, BAP, chrysene, fluoranthene, phenanthrene, and pyrene].
- Area 2: PCBs (Aroclor-1254).
- Area 3: Pesticides (4,4'-DDT, 4,4'-DDE, and 4,4'-DDD).
- Area 4: Pesticides (4,4'-DDE, 4,4'-DDD, alpha-chlordane, and gamma-chlordane).

2.1.5.5 RFI/RI Recommendations

As noted above, the RFI/RI recommended that a FS or CMS be conducted to evaluate capping/covering options for the landfill to protect ecological receptors from exposure to soil and to prevent erosion of soil into the sediment.

Because site groundwater is not considered as a viable drinking water source and because groundwater migration does not pose a threat to surrounding surface water and sediment through groundwater migration, the RFI/RI recommended that groundwater not be considered in a FS/CMS. However, long-term monitoring of groundwater was identified as a provision of the Interim ROD signed in September 2000.

Evaluation of the surface water data in the Site 3 RFI/RI indicated that exposure to surface water by human receptors resulted in acceptable risks and that ecological risks posed by surface water COPCs were negligible. Consequently, remediation of the surface water is not needed for protection of human health or the environment and surface water does not need to be considered in a FS/CMS.

Although the sediment data does not suggest the presence of significant widespread sediment contamination, the RFI/RI recommended that potential contamination at the four areas of sediment on the pond side of the causeway should be evaluated in an FS/CMS.

Based on the conclusions in the RFI/RI, surface soil and sediment were identified as the primary media of concern at Site 3, and the contaminants of concern (COCs) were PAHs, PCBs, pesticides, and metals. An FS/CMS, which was completed in June 2000 (TtNUS, June 2000), developed and evaluated potential remedial alternatives and corrective measures for addressing risks to human health and the environment posed by soil and sediment at Site 3.

2.2 Interim Response Action

An Interim ROD that addressed the risks posed by the waste materials and the most significantly impacted sediment was signed in September 2000 (TtNUS, September 2000). The IRA, completed between August 2000 and July 2001, consisted of the following actions:

- Placement of a protective soil cover over the top and both sides of the causeway to prevent humans and wildlife from contacting waste material.

- Stabilization of both of the causeway's banks by regrading, adding rip-rap (rocks), and planting vegetation along the sides of the causeway.

- Construction of a paved road along the top of the causeway (reducing infiltration of precipitation into waste material and reducing erosion of cover material).

- Covering the four areas of contaminated sediment in the pond with 1 foot of soil, a layer of fabric, and 1 foot of rocks to prevent direct contact with contaminated sediment by aquatic organisms, wildlife, and humans (sediments on the marsh side did not present risks that warranted remedial action).

Figure 3, in addition to showing contaminated sediment Areas 1, 2, 3, and 4 on the pond side of the causeway, also shows the locations of the Historical Edge of the Causeway, the 2001 Extent of Landfill Cover, the 1998 and 1999 pre-IRA sediment samples (not labeled on the figure), and the 2001 and 2003 post-IRA sediment samples. Based on localized site conditions, most if not all of the pre-IRA pond-side sediment sample locations were covered during the IRA. However, although the marsh side bank of the causeway was covered with a protective soil cover during the IRA as part of the causeway bank stabilization, the majority of the pre-IRA marsh-side sediment sample locations were not covered.

The following provisions were also identified in the Interim ROD:

- Re-characterization of sediment after implementation of the IRA.

- Implementation of land use controls (prohibition of unauthorized intrusive/construction activities, prohibition of swimming and wading, prohibition of residential development of the site and the use of the site's groundwater as potable water, and prohibition of subsistence fishing).

- Long-term monitoring of the groundwater (annual groundwater testing for 5 years) (even though the groundwater at the site is not currently used as a potable water supply at the site nor is it expected to be used in the future as a potable water supply).

3.0 POST-CONSTRUCTION SAMPLING ACTIVITIES

3.1 <u>2001 Sediment Sampling</u>

As noted above, re-characterization of the sediment was a provision of the Interim ROD. Sediment sampling was to be completed 90 days after completion of the interim remedy to allow site conditions to stabilize. Twenty sediment samples (as decided during December 2000 and February 2001 MCRD Parris Island Partnering Team meetings) were collected in October 2001. Fifteen samples were collected on the pond side of the causeway, and five samples were collected on the marsh side of the causeway.

The samples were collected in depositional areas just beyond the edge of the newly installed rip-rap and cover fabric (2 to 15 feet from the toe of the recently built slope). The sediment sample locations are shown on Figure 3 (PAI-03-SD-41 through PAI-03-SD-60).

The analytical program was based on the results of the pre-interim remedy sediment sampling and the COCs identified for each area (Table 5). The marsh-side samples (PAI-03-SD-41 through 45) were analyzed for PAHs, PCBs, select metals (arsenic, copper, lead, mercury, and zinc), and select pesticides (4,4'-DDT, 4,4'-DDE, 4,4'-DDD, alpha-chlordane, and gamma-chlordane). The pond-side samples were collected from the four areas of concern identified in the RFI/RI Report (TtNUS, November 1999). Area 1 samples (PAI-03-SD-46 through PAI-03-SD-49) were analyzed for PAHs and select metals, Area 2 samples (PAI-03-SD-50 through PAI-03-SD-52) were analyzed for PCBs and select metals, and Area 3 samples (PAI-03-SD-53 through PAI-03-SD-55) and Area 4 samples (PAI-03-SD-56 through PAI-03-SD-60) were analyzed for select pesticides and select metals.

Field Forms generated during the 2001 sediment sampling are included in Appendix A-1.

3.2 2003 Sediment Sampling

The evaluation of the sediment samples collected in 2001 indicated that one of the sediment samples within Pond Side Area 4 (PAI-03-SD-59) contained 4,4'-DDD at an elevated concentration (see Section 4.0). It was decided during August 2002 and November 2002 MCRD Parris Island Partnering Team meetings that U.S. EPA would collect additional samples in the area of PAI-03-SD-59 to determine if the elevated concentrations in PAI-03-SD-59 were isolated detections. Three sediment samples (PAI-03-SD-61 through PAI-03-SD-63) were collected by U.S. EPA in April 2003 (Figure 3) with a small bottom dredge. Based on an evaluation of the 2001 sediment data collected in Pond Side Area 4, sediment samples collected in 2003 were analyzed for 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, arsenic, lead, mercury, and total organic carbon (TOC) (Table 5).

Field notes generated during the 2003 sediment sampling are included in Appendix A-2.

3.3 2009 Fish Tissue Sampling

Based on the results of a limited interview with a site-specific civilian fisher person (Appendix B), who can be classified as a highly exposed individual (U.S. EPA, 1992), and on regulatory agency comments received on the draft of this Technical Memorandum, fish tissue samples were collected by TtNUS from the 3rd Battalion Pond. Additional samples were collected from General's Landing Creek (selected as a reference location). The sample collection mobilization occurred from October 26 through October 31, 2009. The fish collection activities were authorized by South Carolina Department of Natural Resources (SCDNR) Scientific Collecting Permit Number F-09-46. The fish collection methodology, summarized below, was the same for the 3rd Battalion Pond as for the reference location.

Per the Quality Assurance Project Plan (QAPP) (TtNUS, October 2009), fish were collected from four areas within the 3rd Battalion Pond (Figure 4) to obtain adequate spatial coverage of the pond.

The methodology in U.S. EPA's Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories (November 2000) was suggested as a guide by U.S. EPA due to the presence of a highly exposed individual. This guidance recommends collection of one top predator and one bottom feeder as target species for human health risk assessments. In each area within the pond, two samples of top predators (red drum or croaker) and two samples of bottom feeders (mullet) were proposed for collection for a total of 8 top predators and 8 bottom feeders from the 3rd Battalion Pond. In addition, four samples of top predators (red drum or croaker) and four samples of bottom feeders (mullet) were proposed for collection for tissue analysis from General's Landing Creek (reference location shown on Figure 5).

The species targeted for collection were red drum (*Sciaenops ocellatus*) (top predators) and striped mullet (*Mugil cephalus*) (bottom feeders). Croaker (*Micropogonias undulatus*) (top predators) were identified in the QAPP as an alternate to red drum if red drum were not caught in sufficient numbers. As top predators, red drum and croakers are good indicators of contaminant (copper and mercury) transfer through the food chain. As primarily bottom feeders, mullet have increased exposure to contaminants in sediment (DDx and PCBs).

An attempt was made to collect fish that were of edible and legal size. The potential for receptors to harvest other-than-legal size fish is addressed in the uncertainty section of the HHRA (Section 5.5). SCDNR sport fishing regulations specify that size limits (commonly known as slot size) for red drum are 15 inch minimum [38.1 centimeters (cm)] and 23 inch maximum (58.4 cm) (recreational and subsistence fisher persons may legally keep red drum within this 15 to 23 inch range, and are not allowed to posses red drum smaller than 15 inches or larger than 23 inches). Although red drum of this slot size were preferred for this project, the SCDNR Scientific Collecting Permit allowed the field team to keep any red drum collected, regardless of size. There is no size limit on mullet, but mullet of at least 12 inches in length were targeted for this project. Note that all fish lengths in this report are "total length", which refers to the length from the tip of the snout to the tip of the longer lobe of the caudal fin, measured with the lobes compressed along the midline. Total length is a straight-line measure, not measured over the curve of the body.

Monofilament gill nets were the primary method of fish collection. Four gill nets 125 feet long by 6 feet deep, with mesh sizes of 0.5, 1.0, 1.5, 2.0, and 2.5 inches and four gill nets 100 feet long by 6 feet deep, with mesh sizes of 1.0, 1.5, 2.0, and 2.5 inches were used during the fish collection activities. Attempts were also made to collect fish using cast nets, and hook and line. Upon collection, target fish were immediately placed on wet ice for processing. Non-target fish were returned to the water.

Collected target fish were identified by species, measured for total length and weight, and examined carefully for external anomalies (fin erosion, skin ulcers, skeletal anomalies, and neoplasms, etc.). After recording the species, length, weight, and other pertinent information for each fish collected on Data Sheets (Appendix A-3), individual whole fish samples were then wrapped in aluminum foil, placed in plastic bags, and shipped to the analytical laboratory for next morning arrival. Samples shipped on the same day they were harvested were shipped unfrozen with wet ice. Samples not shipped on the same day they were harvested, were frozen using dry ice, and then shipped with additional dry ice. The sample handling, preservation, and shipping requirements for the fish samples were identified in the site-specific Fish Tissue Sampling SOP (Appendix D of the Quality Assurance Project Plan, TtNUS, October 2009).

The analytical program for the fish tissue samples was based on discussions with U.S. EPA and SCDHEC following their review of an earlier revision of this Technical Memorandum (July 2008), and interim proposed revisions to the document. The fish tissue samples collected from the 3rd Battalion Pond and from General's Landing Creek were analyzed for 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, dioxin-like PCBs congeners, mercury and copper.

Each whole fish was submitted to Katahdin Analytical Services (KAS) where standard fillets were taken from the left side of each fish for contaminant analysis, except where both left and right fillets were needed to supply enough tissue to support all of the required analyses, or where the right fillet was used to produce a field duplicate sample (Table 6). Standard fillets are skin on and scales off with the belly flap included. When filleting, care was taken to ensure fish entrails were not punctured and visible bones were removed. The fish were filleted on clean, decontaminated surfaces (cleaned and rinsed first with deionized water and then with isopropyl alcohol when the species or the station changed).

Fat deposits, visible bones, and viscera were removed from the fillet with a stainless steel knife and deionized water. This stainless steel knife was cleaned and rinsed first with deionized water and then with isopropyl alcohol when the species or the station changed.

The fillets from each fish were weighed and the weights recorded. The stainless steel platform scale pan was cleaned and rinsed first with deionized water and then with isopropyl alcohol when the species or the station changed. Fillets were weighed to the nearest gram with the platform scales.

After weighing, the individual fillets were homogenized in a stainless steel blender in accordance with U. S. EPA Region 4 SOP for Tissue Sample Handling and Processing (SESDPROC-602-R0, May 31, 2007). Dry ice was used as needed in accordance with the SOP to prepare the homogenized sample. 50 grams of the processed fillet were frozen and shipped to SGS North America, Inc. for PCB analysis.

The dates of processing of each sample, the fillet used for analysis, the sex of each fish, and the identification of the blender used to process each sample are listed in Table 6.

Fish tissue field forms, chain-of-custody forms, and field notes generated during the 2009 fish tissue sampling are included in Appendix A-3.

3.3.1 3rd Battalion Pond

Fish collection in the 3rd Battalion Pond was conducted October 26 to October 28, 2009. Weather conditions during this three-day period included overcast skies with temperatures ranging from 59°F to 84°F and rain occurring only on October 27 (a period of nearly an hour).

The 3rd Battalion Pond is connected to the tidal waters on the southwest side of the causeway by two sets of culverts and weirs (Figure 4). The pond receives tidal inflow via these culverts during tides of approximately 8.3 feet or higher. Daily high tides at MCRD Parris Island during the fish collection activities (October 26 to October 28) were less than 6.9 feet and as a result, the 3rd Battalion Pond was not impacted by tidal fluctuation during the sampling period.

Seven red drum, three black drum (*Pogonius cromis*) and eight mullet were caught in the 3rd Battalion Pond and were processed and shipped to the analytical laboratory. Sample identification numbers and lengths and weights of individual fish by quadrant are presented in Table 6. One red drum (PAI-03-RD-01-02) was caught from the shore in Quadrant 1 using a rod and reel. All other fish collected from the 3rd Battalion Pond were captured using gill nets. No croakers were caught in the 3rd Battalion Pond. Several striped mullet were captured in gill nets and were released, as were numerous Atlantic menhaden (*Brevoortia tyrannus*) and pinfish (*Lagodon rhomboids*). Other fish captured in gill nets and cast nets included spot (*Leiostomus xanthurus*), sheepshead (*Archosargus probatocephalus*), spotted seatrout (*Cynoscion nebulosus*), Southern flounder (*Paralichthys lethostigma*), and ladyfish (*Elops saurus*).

No fish collected in the 3rd Battalion Pond displayed external gross morphological abnormalities such as fin erosion, skin ulcers, skeletal anomalies, etc.

As mentioned earlier, red drum between 15 and 23 inches (38.1 to 58.4 cm) were preferred as samples for this investigation. As shown in Table 6, the lengths of two of the red drum from the 3rd Battalion Pond (48.8 cm and 54.3 cm) were within this range. The lengths of two other red drum from the pond (32.2 cm and 33.8 cm) were about two inches (4.3 and 5.9 cm) less than the slot size, with the remaining three red drum from the 3rd Battalion Pond exceeding the slot size, at 82.0 cm or greater.

The eight mullet retained from the 3rd Battalion Pond ranged in length from 33.9 cm (13.3 inches) to 52.0 cm (20.5 inches). Thus, all exceeded the desired minimum length of 12 inches (30.5 cm).

As per the objectives of the QAPP, two red drum were collected from each of three of the four quadrants in the 3rd Battalion Pond (Quadrants 1, 3, and 4) and two mullet were collected from each of the four quadrants in the pond. After three days of fish collection at the 3rd Battalion Pond, only one red drum had been collected from Quadrant 2. Therefore, in accordance with the QAPP and with the concurrence of the TtNUS Project Manager, a decision was made to retain three black drum collected in Quadrant 2 for laboratory analysis as a surrogate for the single absent red drum. Croaker were identified in the QAPP as an alternate to red drum if red drum were not caught in sufficient numbers, but no croaker were caught in the 3rd Battalion Pond.

Red and black drum are both members of the family Sciaenidae, the drums and croakers. Both red drum and black drum feed on small fish (menhaden, mullet, spot, mudminnows, pinfish) and crustaceans (shrimp, blue crabs, fiddler crabs) as adults [Chesapeake Bay Program (CBP), undated; Manooch, 1984; and Wenner, 1992). Large black drum also feed on clams and oysters. With respect to potential bioaccumulation of contaminants, both species are extremely long lived. Red drum may live as long as 35 years, while black drum may live as long as 50 years (CBP, undated). Most fish do not live this long, however, and a 20-year-old fish would be unusual for either species.

The SCDNR sport fishing slot size for black drum is 14 to 27 inches (35.6 to 68.6 cm). As shown in Table 6, all three black drum collected from the pond were within this range.

The estimated ages (or age ranges) of fish shown in Table 6 were based on age and growth information in the scientific literature. Age and growth information were available for red drum in South Carolina coastal waters (Wenner, 1992) and this data was used to estimate the age of red drum collected at Parris Island. Red drum in the 15 to 23 inch slot length are from one to three years old. Most red drum are spawned in September and are 14 inches long by the following October or November, when they are around 14 months old (Wenner, 1992). Age and growth information for striped mullet were obtained from a Florida study (Collins, 1985), and augmented with summary information from a South Carolina report (McDonough, undated). Studies of black drum age and growth in brackish South Carolina ponds (Bearden, 1967) and Virginia estuaries (Richards, 1973) were used to estimate ages of black drum. Some references presented age and growth data in the form of scatter plots with a "best fit" line superimposed. There was, therefore, some subjectivity involved in estimating ages based on length. In addition, there is some uncertainty in literature-derived scatter plots of fish ages, since assigning ages to fish based on an examination of scales or otoliths is an inexact science, with experienced biologists often disagreeing about annual rings on a particular scale or otolith.

3.3.2 General's Landing Creek (Reference Location)

The reference location from which fish were collected is a tidal creek known as General's Landing Creek (Figure 5). The reference location was selected based on a review of aerial photographs, historical maps, interviews with Natural Resources personnel at MCRD Parris Island, and a site inspection. The marsh that General's Landing Creek flows through is a large expanse of cordgrass (*Spartina alterniflora*) intersected by smaller tidal channels, and is similar in general conditions to the marsh that Ribbon Creek flows through immediately downstream of the 3rd Battalion Pond.

Fish collection at the reference location was conducted October 29 through 31, 2009. Weather conditions during this period included generally clear to partly cloudy skies with temperatures ranging from 62°F to 80°F. Daily fish collection activities encompassed at least one high tide and one low tide. Gill nets were placed at various locations each day from the mouth of the creek to a point approximately 1.7 miles upstream from the mouth.

Four red drum, one black drum, and four mullet were caught in General's Landing Creek and were processed and shipped to the analytical laboratory. Sample identification numbers and lengths and weights of individual fish from the reference location are presented in Table 6. All fish retained for laboratory analysis from the reference location were captured in gill nets. The QAPP targeted four red drum and four mullet from the reference location. The single black drum was kept and sent to the laboratory for tissue analysis to compare to tissue data from the three black drum captured in the 3rd Battalion Pond. Several mullet were captured in gill nets and were released, as were numerous Atlantic menhaden and pinfish. Other fish captured in gill nets, cast nets, or hook and line included Atlantic menhaden, pinfish, spot, sheepshead, spotted seatrout, Southern flounder, ladyfish, croaker, bluefish (*Pomatomus saltatrix*), Southern kingfish (*Menticirrhus americanus*), tarpon (*Megalops atlanticus*), hardhead catfish (*Arius felis*), bonnethead shark (*Sphryna tiburo*), and unidentified sharks and rays. A few stone crabs (*Menippe mercenaria*) and blue crabs (*Callinectes sapidus)* were also caught in gill nets at the reference location.

No fish collected in at the reference location displayed external gross morphological abnormalities such as fin erosion, skin ulcers, skeletal anomalies, etc.

The length of one of the red drum from the reference location was slightly less than the slot size of 15 to 23 inches (38.1 to 58.4 cm), at 35.2 cm (13.9 inches). The length of one other red drum was slightly greater than the slot size, at 59.3 cm (23.3 inches). Lengths of the remaining two red drum from the reference location were within the slot size (Table 6).

The length of the single black drum from the reference location was 27.2 cm, which is less than the SCDNR sport fishing slot size for black drum (35.6 to 68.6 cm).

The eight mullet retained from the reference location ranged in length from 32.0 cm (12.6 inches) to 48.9 cm (19.3 inches). Thus, all exceeded the desired 12 inch (30.5 cm) minimum length.

4.0 ANALYTICAL RESULTS

4.1 2001 Sediment Samples

Concentrations of parameters detected at least once in sediment samples collected at Site 3 in October 2001 are presented in Table 7 and the entire October 2001 data set is provided in Appendix C-1. Fourteen PAHs, five pesticides, and five metals were detected in the sediment samples. PCBs were not detected in the 2001 samples. Table 8 provides a summary of the data (frequency of detection, range of detected concentrations, range of non-detect values, location of the maximum detection, average of detected concentrations, and average of all results) for the sediment samples collected in October 2001.

PAHs were detected in all five samples collected from the marsh side and in three of the four samples collected from Area 1 on the pond side of the causeway. The maximum concentrations of all PAHs were detected in the duplicate sample collected at PAI-03-SD-41 (marsh side). PAHs were also detected in the non-duplicate sample at this location but at concentrations approximately 10 times less than in the duplicate sample. This variability can occur in solid samples when chemical detections are low and contaminants are concentrated in isolated particles. For evaluation purposes, the average of the duplicate and non-duplicate samples was used as the representative concentration for this location.

4,4'-DDT was detected in 5 of 13 samples, with the maximum concentration (12 µg/kg) at sample location PAI-03-SD-41 (marsh side). 4,4'-DDD and 4,4-DDE were detected in 6 of 13 samples and 12 of 13 samples at maximum concentrations of 58 and 26 µg/kg, respectively, (sample location PAI-03-SD-59 in Pond Side Area 4). Alpha-chlordane and gamma-chlordane were detected in 2 of 13 samples at maximum concentrations of 6.6 µg/kg (PAI-03-SD-42 – marsh side) and 3.4 µg/kg (PAI-03-SD-54 – Pond Side Area 3), respectively.

Arsenic, copper, lead, mercury, and zinc were detected in all 20 sediment samples. Arsenic and copper were detected at maximum concentrations of 13.6 and 27.1 mg/kg, respectively, at sample location PAI-03-SD-44 (marsh side). Lead was detected at a maximum concentration of 44.9 mg/kg at location PAI-03-SD-60 (Pond Side Area 4). Mercury was detected at a maximum concentration of 0.2 mg/kg at location PAI-03-SD-48 (Pond Side Area 1), and zinc was detected at a maximum concentration of 93.3 mg/kg at location PAI-03-SD-58 (Pond Side Area 4).

During an initial evaluation of the data, the 2001 sediment data were compared to background/typical facility concentrations for metals and pesticides in sediment, U.S. EPA Screening Levels for Chemicals at Superfund Sites (U.S. EPA, May 2009), and U.S. EPA Region 4 ESVs (see Tables 7 and 8 and Figure 6). A more detailed ecological evaluation of the data is presented in Section 6.0.

As per U.S. EPA Region 4 guidance, the background/typical facility pesticide concentrations for sediment presented in Tables 7 and 8 and used for screening of the post-IRA sediment data are two times the mean concentrations calculated for each parameter detected in background/typical facility pesticide sediment samples collected at MCRD Parris Island. Further details on the background/typical facility pesticide data for sediment are presented in Appendix D.

PAHs are a complex class of chemicals; therefore, BAP equivalent values are used for human health comparison, and total PAH values are used for ecological comparison. The BAP equivalent values and total PAH values were calculated for the 2001 sediment samples (see Appendix E). Even though the BAP equivalent values exceeded human health criteria at all but one 2001 sediment sample location (PAHs were not detected in PAI-03-SD-46-01 – Pond Side Area 1), the concentrations detected in 2001 (Table 7) are less than concentrations detected in the 1998 samples (Table 3).

Because direct exposures (e.g., incidental ingestion and dermal contact) were within U.S. EPA acceptable risk levels in the initial RFI/RI HHRA (Table 2), and the sediment PAH concentrations in the post-IRA sediment samples (2001) are less than the concentrations detected in the pre-IRA sediment samples (1998), the HHRA presented in Section 5.0 will only evaluate potential exposures to recreational users through fish ingestion.

Although several individual PAH concentrations exceeded U.S. EPA Region 4 ESVs in two samples collected in 2001, only the maximum total PAH value exceeded the ESV for total PAHs (duplicate sample collected at location PAI-03-SD-41). The concentrations of PAHs in the original sample collected at this location are much less and averaging the concentrations in these two samples results in a total PAH value less than the ESV for total PAHs.

With the exception of arsenic, the maximum detected concentrations of pesticides and metals do not exceed U.S. EPA Screening Levels for residential development (exposure to soil), indicating that these chemicals do not represent a potential threat to human health even under an unrestricted use scenario. Site-specific risk estimates for exposure to sediment would be less than exposure to soil because exposure frequencies, etc are less for sediment than for soil. For arsenic, the average and maximum detected concentrations at Site 3 were 4.7 mg/kg and 13.6 mg/kg, respectively, compared to a residential screening level of 0.39 mg/kg. However, arsenic is a common naturally occurring metal, and, as shown in Table 8, arsenic present in the site sediments (maximum concentration – 13.6 mg/kg) is essentially equivalent to background levels in sediment (12.6 mg/kg) and therefore does not represent a significant incremental risk to human health through incidental ingestion of or direct contact with sediments.

4,4'-DDD, arsenic, copper, lead, and mercury were detected in one or more samples at concentrations that exceeded background/typical facility pesticide concentrations in sediment and the U.S. EPA Region 4 ESVs, indicating potential risk to ecological receptors. However, the average concentrations for these five compounds in Site 3 sediments are less than the background/typical facility pesticide concentrations in sediment (Table 8).

The 2001 sediment sample results are discussed individually for marsh-side samples and samples collected in the four pond-side areas below. Detected concentrations in all of the post remedy 2001 samples decreased for all analyzed chemicals when compared to the pre remedy 1998 and 1999 sediment sample results.

4.1.1 Marsh Side Samples

Most of the 1998 marsh-side sample locations were not covered during the interim response action because sediments on the marsh side of the causeway were shown in the Site 3 RFI/RI to not pose a risk. To determine if the post-IRA sample results (2001 samples) differ from the pre-IRA sample results (1998 samples), Table 9 presents a comparison of the two data sets. This table includes average concentrations for the 1998 and the 2001 marsh-side sediment samples (calculations provided in Appendix F). The background/typical facility pesticide concentrations in sediment, U.S. EPA Screening Levels, and U.S. EPA Region 4 ESVs are also presented in Table 9. Overall, the 1998 and 2001 sediment sample results are similar.

The BAP equivalents in all 2001 marsh-side samples exceeded the U.S. EPA Screening Level for BAP (human health). However, as noted above, the concentrations of PAHs in the 2001 sediment samples do not present unacceptable risks. Although the maximum concentration of total PAHs, detected in the duplicate sample collected in 2001 from location PAI-03-SD-41, exceeded the U.S. EPA Region 4 ESV for total PAHs, the average total PAH value at this location did not exceed the ESV for total PAHs.

As shown on Table 9, although concentrations of pesticides exceeded the U.S. EPA Region 4 ESV in several marsh-side sediment samples (1998 and 2001), the concentrations did not exceed the background/typical facility pesticide concentrations in sediment or the U.S. EPA Screening Levels for human health.

Arsenic was detected in all sediment samples from the marsh at concentrations that exceeded the U.S. EPA Screening Level for human health. In addition, the concentrations of arsenic in several samples from the marsh exceeded the U.S. EPA Region 4 ESV. However, the maximum detection of arsenic in the 2001 marsh-side samples was the only detection of arsenic that exceeded the background sediment concentration.

Copper was not detected in any of the marsh samples at concentrations that exceeded the U.S. EPA Screening Level for human health, but was detected at concentrations that exceeded the U.S. EPA Region 4 ESV in one of the five samples collected in 1998 and two of the five samples collected in 2001. Several additional samples contained concentrations of copper above background sediment concentrations.

Lead was not detected in any of the marsh samples at concentrations that exceeded the U.S. EPA Screening Level for human health, and was detected in only one of the five 1998 samples at a concentration that exceeded both the background sediment concentrations and the U.S. EPA Region 4 ESV values. The maximum concentration of lead in the 2001 samples was the only 2001 concentration that exceeded the background sediment concentration. However, the concentration of lead in this sample did not exceed the U.S. EPA Region 4 ESV.

Mercury was not detected in any of the marsh samples at concentrations that exceeded the background sediment concentrations, the U.S. EPA Screening Level for human health, or the U.S. EPA Region 4 ESV.

Zinc was detected in several samples at concentrations that exceeded the background sediment concentration, but did not exceed the U.S. EPA Screening Level for human health or the U.S. EPA Region 4 ESV.

4.1.2 Pond Side Area 1 Samples

The Pond Side Area 1 sediment samples were analyzed for PAHs and metals. PAHs were detected in three of the four samples collected from the Pond Side Area 1 samples and arsenic, copper, lead, mercury, and zinc were detected in all four samples. The concentrations of PAHs detected in the three samples were greater than the U.S. EPA Screening Level for BAP (human health), but were less than the U.S EPA Region 4 ESVs for total PAHs.

Arsenic was detected in all four samples at concentrations that exceeded the U.S. EPA Screening Levels (human health) and the maximum concentration of arsenic exceeded the U.S. EPA Region 4 ESV. However, none of the concentrations of arsenic exceeded the background sediment concentration for arsenic.

The maximum concentration of copper was the only detection of copper that exceeded the background sediment concentration. However, none of the concentrations of copper detected in the Pond Side Area 1 samples exceeded the U.S. EPA Screening Level (human health) or the U.S. EPA Region 4 ESV.

Lead and zinc were not detected in any of the samples at concentrations that exceeded background sediment concentrations, U.S. EPA Screening Levels (human health), or U.S. EPA Region 4 ESVs.

The maximum concentration of mercury was the only detection of mercury that exceeded the background sediment concentration and the U.S. EPA Region 4 ESV. None of the concentrations of mercury exceeded the U.S. EPA Screening Level.

4.1.3 Pond Side Area 2 Samples

The Pond Side Area 2 sediment samples were analyzed for PCBs and metals. PCBs were not detected in any of the samples, while arsenic, copper, lead, mercury, and zinc were detected in all three Pond Side Area 2 samples.

All concentrations of arsenic exceeded the U.S. EPA Screening Level (human health) and two of the concentrations exceeded the U.S. EPA Region 4 ESV for arsenic. However, none of the concentrations exceeded the background sediment concentration for arsenic.

Only the maximum concentrations of copper and lead exceeded background sediment concentrations and U.S. EPA Region 4 ESVs. None of the concentrations of copper and lead exceeded the U.S. EPA Screening Levels (human health).

Mercury was detected at concentrations that exceeded the background sediment concentration at two of the three sample locations and zinc was detected at concentrations that exceeded the background sediment concentration at all three sample locations. However, none of the concentrations of mercury or zinc exceeded the U.S. EPA Screening Level or the U.S. EPA Region 4 ESV.

4.1.4 Pond Site Area 3 Samples

The Pond Side Area 3 sediment samples were analyzed for pesticides and metals. Pesticides were detected in two of the three sample locations and arsenic, copper, lead, mercury, and zinc were detected in all three sample locations.

Several pesticides were detected at concentrations that exceeded their U.S. EPA Region 4 ESVs. However, none of the pesticides were detected at concentrations that exceeded the background/typical facility pesticide concentration for sediment or the U.S. EPA Screening Levels (human health).

All concentrations of arsenic exceeded the U.S. EPA Screening Level (human health) However; none of the concentrations exceeded the background sediment concentration or the U.S. EPA Region 4 ESV for arsenic.

None of the concentrations of copper, lead, mercury, and zinc exceeded background sediment concentrations, U.S. EPA Screening levels or U.S. EPA Region 4 ESVs.

4.1.5 Pond Side Area 4 Samples

The Pond Side Area 4 sediment samples were analyzed for pesticides and metals, which were detected in all five samples collected in Area 4. Pesticides were detected in various samples at concentrations that exceeded the U.S. EPA Region 4 ESVs. However, the maximum concentration of 4,4'-DDD was the only concentration of pesticides that exceeded the background/typical facility concentrations for sediment and none of the concentrations of pesticides exceeded the U.S. EPA Screening Level (human health).

All concentrations of arsenic exceeded the U.S. EPA Screening Level (human health) However; none of the concentrations exceeded the background sediment concentration or the U.S. EPA Region 4 ESV for arsenic.

The maximum concentration of copper was the only detection of copper that exceeded the background sediment concentration. However, none of the concentrations of copper detected in the Pond Side Area 4 samples exceeded the U.S. EPA Screening Level (human health) or the U.S. EPA Region 4 ESV.

Lead was detected at two sample locations at concentrations that exceeded the background sediment concentration and the U.S. EPA Region 4 ESV. None of the lead concentrations exceeded the U.S. EPA Screening Levels.

Mercury was detected at concentrations that exceeded the background sediment concentration for mercury and the U.S. EPA Region 4 ESV at four of the five Pond Side Area 4 samples. None of the concentrations of mercury exceeded the U.S. EPA Screening Level (human health).

Zinc was detected at concentrations that exceeded background sediment concentrations at four of the five Pond Side Area 4 samples. However, none of the concentrations exceeded the U.S. EPA Screening Level or the U.S. EPA Region 4 ESV.

4.2 2003 Sediment Samples

Three sediment samples were collected from Area 4 of the Pond side of the causeway in 2003 to determine if the elevated pesticide concentrations in PAI-03-SD-59 were isolated detections. Based on an evaluation of the 2001 sediment data from Pond Side Area 4, the samples collected in 2003 were analyzed for 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, arsenic, lead, and mercury. Table 10 provides a summary of the analytical results for the 2003 sediment samples and the 2003 data is provided in Appendix C-2. 4,4'-DDD (two of three samples) and 4,4'-DDE (three of three samples) were the only pesticides detected in the 2003 sediment samples. Arsenic and lead were detected in all three sediment samples. 4,4'-DDT and mercury were not detected in these three samples. Comparison of the 2003 sediment sample results (Table 10) to the results from PAI-03-SD-59-01 (Table 7) indicates that the 2003 pesticide concentrations were an order of magnitude less than the pesticide concentrations detected in PAI-03-SD-59-01 in 2001. The 2003 arsenic concentrations were slightly greater in the 2003 samples than in PAI-03-SD-59-01 but were less than the background sediment concentration (Table 10). The lead concentrations in the 2003 samples were less than the concentration detected in PAI-03-SD-59-01 and were similar to the background sediment concentration (Table 10). The results of the 2003 sampling effort indicate that the elevated concentrations of pesticides at PAI-03-SD-59 appear to be an isolated occurrence.

4.3 2009 Fish Tissue Samples

Table 11 provides a summary of the fish tissue data for the samples collected from the 3rd Battalion Pond and from General's Landing Creek (reference location). The table identifies the frequency of detection, the minimum and maximum concentrations, and the average of positive detections for all parameters. The entire October 2009 fish tissue data set is provided in Appendix C-3. All fish tissue weights are presented on a wet-weight basis.

Copper was not detected in any fish collected from either the 3rd Battalion Pond or General's Landing Creek. Mercury was detected in seven of the 18 samples collected from the 3rd Battalion Pond (Quadrants 2, 3, and 4) and in only one of the nine samples collected from General's Landing Creek. Mercury was only detected in red or black drum and was not detected in any of the mullet collected from either the 3rd Battalion Pond or General's Landing Creek.

The concentrations of mercury in fish collected from Quadrant 2 of the pond ranged from 0.0155 to 0.0204 milligram per kilogram (mg/kg). The concentrations of mercury in fish collected from Quadrant 3 and 4 ranged from 0.0455 to 0.564 mg/kg with the highest concentrations of mercury being detected in the largest red drum samples collected, which were all larger than the SCDNR slot size (38.1 to 58.4 cm). The one detection of mercury in fish collected from General's Landing Creek was 0.0235 mg/kg. With the exception of the three largest fish from the 3rd Battalion Pond, mercury concentrations in the fish from the pond were similar to the concentration of mercury in the one fish sample from the reference location.

Four of the PCB congeners analyzed for (PCB-105, PCB-118, PCB-156/157, and PCB-167) were detected in all 18 fish collected from the 3rd Battalion Pond, whereas only two of the PCB congeners (PCB-105, PCB-118) were detected in all 9 of the fish collected from General's Landing Creek. All PCB congeners were detected at least once in the fish from the pond. Three of the PCB congeners (PCB-126, PCB-169, and PCB-81) were not detected in the fish from the reference location.

The concentrations of total dioxin-like PCBs (using "0" for non-detected congeners) in the fish from the pond ranged from 180 to 7,800 nanogram per kilogram (ng/kg) and in the fish from the reference location ranged from 135 to 1,630 ng/kg. The dioxin-like PCBs were detected at higher concentrations in mullet (1,040 to 7,800 ng/kg total dioxin-like PCBs) than in red/black drum (180 to 2,500 ng/kg total dioxin-like PCBs) in the fish from the pond. With one exception, the dioxin-like PCBs were also detected at higher concentrations in mullet (170 to 1,230 ng/kg total dioxin-like PCBs) than in red/black drum (135 to 1,630 ng/kg total dioxin-like PCBs) in the fish from the reference location. The mullet had higher lipid content than the red/black drum which would support the understanding that dioxin-like PCBs accumulate in the lipids. The range of total dioxin-like PCB concentrations presented in terms of toxic equivalent concentrations (TEQs) for the pond and reference area are presented below:

	Concentration Range (ng/kg)
Pond	0.0672 - 7
Reference Area	0.055 – 2.1

The TEQ concentrations were calculated using toxic equivalency factors (TEFs) as discussed in Section 5, the Human Health Risk Assessment. The detection limit was used for non-detected congeners in the calculation of the TEQs.

4,4'-DDE (18 of 18 samples), 4,4'-DDT (13 of 18 samples) and 4,4'-DDD (10 of 18 samples) were detected at a greater frequency in the fish from the pond than in the fish from the reference location (6 of 9 samples, 1 of 9 samples and 1 of 9 samples, respectively). 4,4'-DDE (the most frequently detected pesticide in fish from either the pond or the reference location) was the pesticide detected at the highest concentrations. Concentrations of 4,4'-DDE ranged from 1.5 to 71 micrograms per kilogram (µg/kg) in the fish from the pond and from 0.8875 to 5.1 µg/kg in the fish from the reference location. As with the PCBs, the pesticides were generally detected at higher concentrations in fish with higher lipid content (mullet). Figures 7 through 10 provide the non-normalized and length/lipid normalized Total PCB TEQ concentrations by fish species (red/black drum and mullet).

5.0 HUMAN HEALTH RISK ASSESSMENT

This section presents an evaluation of the human health risks resulting from consumption of fish taken from Site 3 (specifically the 3rd Battalion Pond) and the associated reference area; the analysis is based on fish tissue data collected in 2009.

5.1 Previous Investigations

The analysis was preceded by human health risk assessments presented in the Site 3 RFI/RI report of November 1999 and in draft Technical Memoranda (previous drafts of this document) submitted for review in 2008 and 2009 as detailed in the following narrative. The analyses presented in draft 2008 and 2009 Technical Memoranda considered potential exposures to sediment at Site 3 and fish from the 3rd Battalion Pond using sediment data collected by TtNUS in October 2001 and U.S. EPA in April 2003 and fish tissue data collected by TtNUS in October 2009.

The HHRA presented in the Site 3 RFI/RI Report (TtNUS, November 1999) evaluated potential exposures to sediment by construction workers and maintenance workers via direct contact exposures, and recreational fisherman via fish ingestion (conservative and site-specific). Potential risks for direct contact exposures (e.g., incidental ingestion and dermal contact) to sediment were within U.S. EPA acceptable risk levels. The HHRA in the RFI/RI also used the sediment data to estimate risks to human health through theoretical partitioning of sediment contaminants to fish and subsequent human consumption of the fish by recreational fisherman. Risks for exposures through ingestion of fish using stringent exposure assumptions exceeded U.S. EPA target risk levels. In addition, the HHRA in the RFI/RI estimated risks to human health through ingestion of fish using fish tissue data collected as part of the EIS in 1991. Risks for this pathway exceeded the U.S. EPA target risk levels for the conservative recreational fisherman.

Because direct contact exposures (e.g., incidental ingestion and dermal contact) were within U.S. EPA acceptable risk levels in the initial RFI/RI HHRA, and the sediment concentrations in the post-IRA samples are not significantly different than the pre-interim remedial action samples, this HHRA only evaluates potential exposures to recreational users through ingestion of fish.

Initially, potential exposures to recreational fisherman through ingestion of fish were evaluated using theoretical partitioning of post-IRA sediment contaminants to fish and subsequent human consumption of fish by recreational fisherman. Based on comments received from both U.S. EPA Region 4 and SCDHEC, the draft of this Technical Memorandum that was submitted by TtNUS in July 2008 was revised in January 2009 but not formally submitted at that time to the regulatory agencies for their review. The revision was posted to an FTP site and was accessible to all Partnering Team members. Revisions included changes to the exposure assumptions for identified receptors as a result of a subsequent interview with one local civilian fisher person (Appendix B) known to frequently fish at the 3rd Battalion Pond, the only person interviewed. Relying solely on the results of the interview with this one fisher person, the assumption was made that a highly exposed individual may exist that potentially consume more fish than was assumed during the preparation of the Draft Technical Memorandum in which other fish ingestion rates were used to calculate risks. The reported consumption rates by the interviewed fisher person likely exceed Food and Drug Administration (FDA) and U.S. EPA recommendations and are not representative of the typical use of the site because of noncompliance with posted signing at the Site 3 Pond. Subsequent discussions with U.S. EPA Region 4 and SCDHEC on the proposed revisions to the Draft Technical Memorandum have indicated concerns with the proposed revisions, especially with the methods used to estimate potential fish tissue concentrations using sediment data, and with the exposure assumptions for the selected exposure scenarios.

A comparison of the maximum sediment concentration for all chemicals detected in the 2001 and 2003 sediment samples from the 3rd Battalion Pond to background/typical facility pesticide concentrations is presented in Table 12. As shown in Table 12, 4,4'-DDD, copper, lead, mercury, and zinc were detected in the sediments from the 3rd Battalion Pond at maximum concentrations that are greater than background/typical facility pesticide concentrations (as defined in Appendix D). Background concentrations were not established for the PAHs reported in Table 12.

U.S. EPA Region 4 considers bioaccumulative chemicals to include those designated in Bioaccumulation Testing and Interpretation for the Purpose of Sediment Quality Assessment (U.S. EPA, February 2000), except for PAHs. U.S. EPA Region 4 considers the potential toxicity of PAHs via bioaccumulation in the food web to be generally negligible unless PAHs are present at extremely high concentrations [i.e., percent levels (10,000 mg/kg)] in soil or sediment. Since PAHs were not detected at such high concentrations in the Pond Side Area 1 sediments at Site 3, and PAH concentrations in fish are usually low because fish rapidly metabolize PAHs (Eisler, April 2000), PAHs were not evaluated for the consumption of fish by recreational users pathway.

Fish tissue concentrations were estimated for those chemicals detected in the 3rd Battalion Pond sediment samples at concentrations greater than background/typical facility pesticide concentrations (4,4'-DDD, copper, lead, mercury, and zinc) using 2001/2003 sediment concentrations and biota-sediment accumulation factors (BSAFs) with the following equation:

$$C_{fish} = \text{BSAF x} \left(C_{sed}/f_{oc}\right) \text{x } f_i$$

Where

C_{fish}	=	estimated chemical concentration in fish tissue (mg/kg)
C_{sed}	=	chemical concentration in sediment (mg/kg)
BSAF	=	biota-sediment accumulation factor
f_{oc}	=	TOC of sediment expressed as a decimal fraction
f_i	=	organism lipid content expressed as a decimal fraction.

Although sediment samples collected in October 2001 were not analyzed for TOC, the samples collected in 2003 were. Based on the 2003 sampling results, a value of 0.01 was used for f_{oc}. The lipid content used was 0.025, which is the average lipid content of the fish collected from the 3rd Battalion Pond (Table 11).

Initially, the BSAFs were obtained from the following sources:

- Organics: The Incidence and Severity of Sediment Contamination in Surface Waters of the United States, National Sediment Quality Survey (U.S. EPA, November 2004).

- Inorganics: Biota Sediment Accumulation Factors for Invertebrates: Review and Recommendations for Oak Ridge Reservation (ORNL, 1998).

U.S. EPA, in their comments on the Draft Technical Memorandum (TtNUS, July 2008) and in subsequent discussions, indicated that bioaccumulation models instead of models generating a dose should be used to estimate fish tissue concentrations from sediment data. They identified the preferred mercury model as Evans and Engel (May 1994) (see Appendix G for more information). U.S. EPA also indicated that a better source of BSAFs for 4,4'-DDT, 4,4'-DDE, and 4,4'-DDD was an United States Army Corps of Engineers (USACE) database available on the USACE website (http://el.erdc.usace.army.mil/bsaf) (see Appendix G for more information). As a result, BSAFs obtained from the following sources were used to estimate fish tissue concentrations:

- 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT: U.S. Army Corps of Engineers (USACE) BSAF Database (http://el.erdc.usace.army.mil/bsaf) (see Appendix G for more information).

- Chlordane: The Incidence and Severity of Sediment Contamination in Surface Waters of the United States, National Sediment Quality Survey (U.S. EPA, November 2004).

- Mercury: Mercury Bioaccumulation in Finfish and Shellfish from Lavaca Bay, Texas: Descriptive Models and Annotated Bibliography. NOAA Tech. Memo NMFS-DEFSC-348. (Evans, D.W. and D.W. Engel, May 1994) (see Appendix G for more information).

- Inorganics (other than mercury): Biota Sediment Accumulation Factors for Invertebrates: Review and Recommendations for Oak Ridge Reservation (ORNL, 1998).

Because sediment-to-fish BSAFs are not available for most metals, sediment-to-aquatic invertebrate BSAFs from ORNL (1998) were used to estimate tissue concentrations in fish. The BSAFs for metals are not normalized to lipids or TOC, so concentrations of metals in benthic invertebrates were estimated by multiplying each COPC's sediment concentration by its associated BSAF and converted to a wet-weight by multiplying by 0.16.

Table 12 provides the BSAFs from the sources cited above and the estimated fish tissue concentrations obtained by using these BSAFs in the equation shown above.

U.S. EPA Region 4 risk assessment guidance recommends using U.S. EPA Regional Screening Levels (U.S. EPA, December 2009) for the selection of COPCs. However, there are no screening levels available for ingestion of fish; consequently U.S. EPA Region 4 recommended that Recommended Screening Values (RSVs) (U.S. EPA, November 2000) be used as the risk-based screening levels and these are presented in Table 12. The RSVs correspond to a systemic HQ of 0.1 (for non-carcinogens) or a lifetime cancer risk of 1×10^{-6} (for carcinogens). Note that the RSVs in the guidance (U.S. EPA, November 2000) are based on a HQ of 1.0, and the RSVs presented in Table 12 are based on a HQ of 0.1. The RSVs used for non-carcinogenic chemicals have been divided by a factor of 10 to further account for the potential cumulative effects of several chemicals affecting the same target organ or producing the same adverse non-carcinogenic health effect.

For those compounds detected in the sediment that do not have RSVs, the Regional Screening Level calculator [Oak Ridge National Laboratory (ORNL), September 2009] and the appropriate exposure assumptions presented in Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories (U.S. EPA, November 2000) were used to calculate the RSVs in Table 12.

Because of the lack of toxicity data, RSVs are not available for some compounds (e.g., alpha- and gamma-chlordane) and surrogates were selected for these chemicals based on similar chemical structures. In the COPC screening, chlordane was selected as a surrogate for alpha- and gamma-chlordane.

Table 12 compares the estimated fish tissue concentrations to the RSVs developed above. This comparison indicates that estimated fish tissue concentrations for 4,4'-DDD, copper, and mercury exceed their associated RSVs. Although the maximum concentration of zinc exceeds the subsistence RSV based on a HQ of 0.1, it does not exceed the subsistence RSV based on a HQ of 1.0 and it does not exceed the recreational RSV. Consequently, post-remedy sediment concentrations of 4,4'-DDD, copper, and mercury could be contributing to unacceptable levels of contamination in fish with respect to human consumption.

As a result, and because of the concerns expressed by U.S. EPA and SCDHEC with the methods used to estimate potential fish tissue concentrations using sediment data and with the exposure assumptions for the identified receptors, fish tissue samples were collected and analyzed (October 2009) to more fully evaluate risks to human health associated with consumption of fish from the 3rd Battalion Pond. In addition to 4,4'-DDD, copper, and mercury, the fish tissue samples collected in October 2009 were also analyzed for 4,4'-DDE and 4,4'-DDT (because of their similarity to 4,4'-DDD) and dioxin-like PCBs. It should be noted that Total PCBs, based on an analysis for the Aroclor mixtures and more specifically Aroclor-1254,were identified as COCs during the evaluation of the fish tissue samples collected in 1991 before the implementation of the IRA.

5.2 Guidance Documents

The following current U.S. EPA and United States Navy risk assessment guidance documents were used to develop the framework for this HHRA:

- Risk Assessment Guidance for Superfund (RAGS): Volume I, Human Health Evaluation Manual (Part A) (U.S. EPA, December 1989).

- Supplemental Guidance to RAGS: Region 4 Bulletins, Human Health Risk Assessment Bulletins (U.S. EPA, May 2000).

- Exposure Factors Handbook. Office of Health and Environmental Assessment (U.S. EPA, August 1997).

- RAGS: Volume I - Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments) (U.S. EPA, December 2001).

- Conducting Human Health Risk Assessments under the Environmental Restoration Program (Navy, February 2001).

- Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories (U.S. EPA, November 2000).

This HHRA consists of five components: selection of COPCs, exposure assessment, toxicity assessment, risk characterization, and uncertainty analysis. Sections 5.3 through 5.7 contain detailed discussions of the five components of the HHRA.

5.3 Selection of COPCs

The selection of COPCs is a qualitative screening process used to limit the number of chemicals quantitatively evaluated in the baseline HHRA to those site-related constituents that dominate overall potential risks.

Maximum fish tissue concentrations (wet-weight basis) for each parameter analyzed in the 2009 fish tissue samples were compared to the appropriate fish tissue screening level to select COPCs that were evaluated in this HHRA in Table 13. To compensate for releases from background/anthropogenic sources, the maximum concentrations from the 2009 3rd Battalion Pond fish tissue data were compared to two times the mean concentrations of the fish tissue data collected from General's Landing Creek (reference location).

In general, a chemical was selected as a fish tissue COPC and retained for further quantitative risk evaluation if the maximum detected fish tissue concentrations in the 3rd Battalion Pond fish tissue samples exceeded two times the mean reference fish tissue concentrations and the appropriate screening levels. Chemicals present in the 3rd Battalion Pond fish tissue samples at concentrations greater than the screening levels but less than two times the mean reference fish tissue concentrations were not considered to be representative of risks associated with Site 3 sediment.

Fish tissues samples were analyzed for dioxin-like PCB congeners, which are defined in the EPA guidance document titled: PCBs: Cancer Dose-Response Assessment and Application to Environmental Mixtures (EPA, September 1996). PCB congeners are classified as either dioxin-like or nondioxin-like. To evaluate the dioxin-like PCB congeners, toxicity equivalency factors (TEFs) which relate the congener concentrations to equivalent concentrations of 2,3,7,8-TCDD were applied to the individual dioxin-like PCB congener concentrations as specified in the EPA guidance. Specifically, the individual dioxin-like PCB congener concentrations are multiplied by the TEFs to produce a 2,3,7,8-TCDD dioxin-like toxic equivalent concentration (TEQ). The detection limit was used for non-detected congeners in the calculation of the TEQs. The individual TEQs were summed for each sample and, for purposes of COPC selection, the maximum total dioxin-like TEQ was compared to the screening criteria for 2,3,7,8-TCDD.

Maximum fish tissue concentrations of the following chemicals exceeded two times the mean concentrations of the fish tissue data collected from General's Landing Creek and the appropriate screening levels; therefore, these chemicals were retained as COPCs at Site 3:

- 4,4'-DDD
- 4,4'-DDE
- 4,4'-DDT
- PCBs (dioxin like)
- Mercury

5.4 <u>Exposure Assessment</u>

The exposure assessment portion of the risk assessment defines and evaluates, quantitatively or qualitatively, the type and magnitude of human exposure to the chemicals present at or migrating from a site. The exposure assessment is designed to depict the physical setting of the site, to identify potentially exposed populations and applicable exposure pathways, to calculate concentrations of COPCs to which receptors might be exposed, and to estimate chemical intakes under the identified exposure scenarios.

A detailed exposure assumption was presented in the Site 3 RFI/RI (TtNUS, November 1999). This section presents only the information used to evaluate exposures to recreational fisherman or subsistence fisherman consuming fish taken from Site 3, specifically the 3rd Battalion Pond or from the reference area.

5.4.1 Exposure Point Concentrations

EPA's ProUCL software (Version 4.00.04) (U.S. EPA, February 2009) contains several methods for dealing with non-detected values when calculating Exposure Point Concentrations (EPCs). U.S. EPA has recommended using the Kaplan-Meier (KM) method, which is a nonparametric estimation method that is a popular statistical method in the medical field. The KM method was used for calculating EPCs for 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, copper, and mercury. The KM method was also used to calculate the EPC for dioxin-like PCBs. However, when totaling the dioxin-like PCB congener concentrations to obtain a TEQ concentration for each individual sample, the detection limit was used for any non-detected values. Tables 14A and 14B present the EPCs for 3rd Battalion Pond and the reference area, respectively.

5.4.2 Chemical Intake Estimation for Ingestion of Fish

The fish consumption exposure pathway was evaluated for adult and child receptors who consume fish taken from the 3rd Battalion Pond and reference area. . Intakes for the fish ingestion exposure route were estimated using the following equation (U.S. EPA, December 1989):

$$\text{Intake} = \frac{(C_{fish})(IR)(FI)(EF)(ED)}{(BW)(AT)}$$

where:

Intake	=	recreational fish ingestion intake (mg/kg-day)
C_{fish}	=	chemical concentration in fish tissue (mg/kg)
IR	=	ingestion rate (kg/meal)
FI	=	fraction ingested from contaminated source (unitless)
EF	=	exposure frequency (meals/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (days);
		for non-carcinogens, AT = ED x 365 days/yr;
		for carcinogens, AT = 70 yrs x 365 days/yr

Exposure assumptions are summarized in Table 15. Four exposure scenarios were evaluated for in this HHRA.

- Military recreational fisherman
- Civilian recreational fisherman
- Civilian subsistence fisherman
- Standard U.S.EPA Region IV default fisherman

Each scenario was based on Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories (U.S. EPA, November 2000), which was suggested as a guide by U.S. EPA due to the presence of a highly exposed individual, or on EPA Region IV specific guidance, with site-specific considerations, where applicable.

The Military Recreational Fisherman

The first exposure scenario assumed that military personnel fished at the site periodically. An ingestion rate (IR) of 17.5 grams per day (averaged over a year) was assumed (U.S. EPA, November 2000). It was also assumed that these adult recreational users were military personnel stationed at the base for two 3-year tours of duty or for a total exposure duration of 6 years (ED). All other exposure parameters for ingestion of fish tissue were standard U.S. EPA Region 4 default values (May 2000). Children of the military recreational user were also evaluated. A body weight of 17 kg was used for the child military recreational user.

<u>The Civilian Recreational User</u>

The second exposure scenario assumed that a civilian recreational receptor fished at the site periodically. Only the years of exposure (ED) for this receptor (70 years) differed from those assumed for the military recreational fisherman (6 years) described in the preceding paragraph. An ED of 70 years was evaluated per the EPA November 2000 guidance assuming that this civilian was residing in close proximity of Site 3 and consumed fish at the site over the course of his/her lifetime. It should be noted that an ED of 70 years is very conservative and is not reflected of the ED term generally used to calculate soil, water, or air screening levels for COPC selection (USEPA, December 2009). An ED value of 30 years is typically used in the calculation of those screening levels).

<u>The Civilian Subsistence Fisherman</u>

The third exposure scenario assumed that a civilian subsistence fisherman fished at the site frequently. An IR of 142.4 gram per day (averaged over a year) was assumed (U.S. EPA, November 2000). This value is similar to the current U.S. EPA Region IV default value grams per meal value of 145 grams. (U.S.EPA Region IV, 2000). A child age 8 to 10 was evaluated under this scenario based on the interview with the site-specific civilian subsistence fisher (Appendix B). The ED for this scenario was also 70 years. All other exposure parameters for ingestion of fish tissue were standard U.S. EPA Region 4 default values (U.S.EPA May 2000, updated September 2008)

<u>Standard EPA Region IV Default Fisherman</u>

The fourth exposure scenario presented in this assessment reflects current standard U.S.EPA Region IV default recommendations regarding the evaluation of the fish consumption scenario. An IR of 54 grams per day (on average) over 350 days per year for a 30-year exposure duration is assumed. The receptor is assumed to be the typical consumer of fish, not a subsistence fisherman. (However, as a point of reference, the Region IV default ingestion rate value for a subsistence fisherman is 145 grams per meal. Therefore, risk estimates for a subsistence fisherman would be approximately 3 times those calculated for standard default (non-subsistence) fisherman.)

5.5 Toxicity Assessment

The objective of a toxicity assessment is to identify the potential for human health hazards and adverse effects in exposed populations. Quantitative estimates of the relationship between the magnitude and type of exposures and the severity or probability of human health effects are defined for the identified COPCs. Quantitative toxicity values [cancer slope factors (CSFs) and reference doses (RfDs)] determined during this component of the risk assessment were integrated with outputs of the exposure assessment to characterize the potential for adverse health effects for each receptor group. A CSF is an indicator of the potency of a chemical carcinogen (i.e., the greater the CSF, the more potent the carcinogen). More formally, a CSF is an upper-bound estimate, approximating a 95-percent confidence limit, on the increased cancer risk from lifetime exposure to a carcinogen. This estimate is usually expressed in units of proportion (of a population) affected per mg/kg/day of a carcinogen. An RfD is the dose at which or below which adverse non-carcinogenic effects are not anticipated.

Oral and inhalation RfDs and CSFs used in the site-specific risk assessments were obtained from the following primary U.S. EPA sources (U.S. EPA, December 2003):

- Integrated Risk Information System (IRIS) (online) (U.S. EPA, June 2010).

- U.S. EPA Provisional Peer Reviewed Toxicity Values (PPRTVs) – The Office of Research and Development/National Center for Environmental Assessment (NCEA) Superfund Health Risk Technical Support Center develops PPRTVs on a chemical-specific basis when requested by U.S. EPA’s Superfund program.

- Other toxicity values – These sources include but are not limited to California Environmental Protection Agency (Cal EPA) toxicity values, Agency for Toxic Substances and Disease Registry (ATSDR) Minimal Risk Levels (MRLs), and Annual Health Effects Assessment Summary Tables (HEAST) (U.S. EPA, July 1997).

Although RfDs and CSFs can be found in several toxicological sources, U.S. EPA's IRIS online database is the preferred source of toxicity values. This database is continuously updated and values presented have been verified by U.S. EPA. Oral RfDs and CSFs for the constituents identified as COPCs for Site 3 are presented in Tables 16 and 17.

5.6 Risk Characterization

This section provides a characterization of the potential human health risks associated with potential exposure to fish tissue COPCs at Site 3. Section 5.4.1 outlines the methods used to quantitatively estimate the type and magnitude of potential risks for human receptors. A summary of the risk characterization for Site 3 is provided in Section 5.4.3.

5.6.1 Quantitative Analysis

Quantitative estimates of risk were calculated according to risk assessment methods outlined in U.S. EPA guidance (December 1989).

Lifetime cancer risks are expressed in the form of dimensionless probabilities, referred to as incremental lifetime cancer risks (ILCRs), based on CSFs. Non-carcinogenic risk estimates are presented in the form of HQs that are determined through a comparison of intakes with published RfDs. ILCR estimates were generated for each COPC using estimated exposure intakes and published CSFs, as follows:

$$\text{ILCR} = (\text{Estimated Exposure Intake})(\text{CSF})$$

If the above equation resulted in an ILCR greater than 0.01, the following equation was used to calculate the ILCR:

$$\text{ILCR} = 1\text{-}[\exp(\text{-Estimated Exposure Intake})(\text{CSF})]$$

An ILCR of 1×10^{-6} indicates that the exposed receptor has a one-in-one-million chance of developing cancer under the defined exposure scenario. Alternatively, such a risk may be interpreted as representing one additional case of cancer in an exposed population of one million people.

As mentioned previously, non-carcinogenic risks were assessed using the concepts of HQs and HIs. The HQ for a COPC is the ratio of the estimated intake to the RfD, as follows:

$$\text{HQ} = (\text{Estimated Exposure Intake}) / (\text{RfD})$$

An HI was generated by summing the individual HQs for all COPCs. The HI is not a mathematical prediction of the severity of toxic effects and therefore is not a true "risk"; it is simply a numerical indicator of the possibility of the occurrence of non-carcinogenic (threshold) effects.

5.6.2 Comparison of Quantitative Risk Estimates to Benchmarks

To interpret the quantitative risk estimates and to aid risk managers in determining the need for remediation, quantitative risk estimates were compared to typical U.S. EPA risk benchmarks. U.S. EPA has defined a "target cancer risk" range of 1×10^{-6} to 1×10^{-4} (i.e., a one-in-ten thousand to one in-one-million chance of developing cancer). Individual or cumulative ILCRs greater than 1 x 10^{-4} are typically not considered as protective of human health, and ILCRs less than 1 x 10^{-6} are typically regarded as protective. HQs and HIs are typically evaluated using a value of 1. Generally, adverse non-carcinogenic health effects are not anticipated if an HQ or HI, developed on a target organ-/effect-specific basis, does not exceed 1 (unity). If an HI exceeds unity, a segregation of target organ effects associated with exposure to COPCs was performed. Only those chemicals that affect the same target organ(s) or exhibit similar critical effect(s) were regarded as truly additive. Consequently, it may be possible for a cumulative HI to exceed 1, but no adverse health effects are anticipated if the COPCs do not affect the same target organ or exhibit the same critical effect.

5.6.3 Results of the Risk Characterization

As defined in Section 5.2.2, the following four receptors were evaluated in this HHRA:

- The Military Recreational Fisherman -
- The Civilian Recreational Fisherman
- The Civilian Subsistence Fisherman
- The Standard U.S. EPA Region IV Default Fisherman

The first scenario (military recreational fisherman) evaluated exposure assumptions based on site-specific considerations for military personnel stationed at the base. The second and third scenarios (civilian recreational fisherman) are based on the guidance specifically recommended by the U.S.EPA for this project (U.S. EPA, November 2000) for the evaluation of recreational and subsistence fishermen. The fourth scenario evaluated the exposure assumptions specifically recommended in the most current EPA Region IV specific guidance. For each scenario, HIs and ILCRs were estimated using the EPCs listed in Tables 14A and 14B for fish tissue samples collected from the Site 3-3rd Battalion Pond and from the General's Landing Creek reference locations, respectively. Potential cancer risks and HIs for the evaluated scenarios are summarized in Tables 18A and 18B and in Figures 5-1 and 5-2. Sample calculations and results of the risk assessment in RAGS Part D format are included in Appendix H.

<u>Child Receptors</u>

The hazard indices calculated for child recreational fisherman (military or civilian) consuming fish taken from the 3rd Battalion Pond and the reference area were 4 and 2, respectively. The HIs calculated for the child subsistence fisherman were 19 and 9 for the 3rd Battalion Pond and the reference area, respectively. Chemical-specific HIs calculated for the dioxin-like PCBs exceed 1 in all cases presented in Tables 18A and 18B indicating a potential for adverse non-carcinogenic health effects under the conditions established in the exposure assessment. However, it should be noted that oral reference doses are not currently available for the dioxin-like PCBs. The oral reference dose for 2,3,7,8-TCDD has been used as a surrogate toxicity criterion for purposes of calculating non-cancer risks (HIs). This is a significant source of uncertainty in the HHRA. The HI calculated for mercury also exceeds 1 when the subsistence fisherman taking fish for the 3rd Battalion Pond is evaluated.

The cumulative ILCR for the child receptors [child military/civilian recreational fisherman (2×10^{-5}) and child subsistence fisherman (7×10^{-5})] consuming fish taken from the 3rd Battalion Pond were within the U.S. EPA target risk range of 10^{-4} to 10^{-6}. As summarized in Table 18B and depicted in Figure 11, the risk estimates calculated for the 3rd Battalion Pond are similar to those calculated for the reference area.

<u>Adult Receptors</u>

Figure 12 compares HIs calculated for the 3rd Battalion Pond to HIs calculated for the reference area. The HIs calculated for adult receptors consuming fish taken from the 3rd Battalion Pond exceed 1 only when the subsistence fisherman (HI = 8) or the standard U.S. EPA Region IV Default Fisherman (HI = 3) are evaluated. The primary risk drivers are the dioxin-like PCBs and mercury. The HI calculated for the subsistence fisherman (HI = 4) taking fish from the reference area also exceed 1. The dioxin-like PCBs are the primary risk driver in this case.

Figure 11 compares the cancer risk estimates for adult receptors taking fish from the 3rd Battalion Pond to the risk estimates developed for the reference area. The cumulative ILCRs for all adult receptors except the adult subsistence fisherman taking fish from the reference area (4×10^{-4}) or the 3rd Battalion Pond (7×10^{-4}) are within the U.S. EPA target risk range of 10^{-4} to 10^{-6}. The Dioxin-like PCBs and 4,4'-DDE are the major contributors to the ILCRs for the adult subsistence fisherman.

The risk estimates displayed in Figures 11 and 12 suggest that the EPCs (particularly those for the dioxin-like PCBs) for the fish tissue samples collected from the 3rd Battalion Pond are marginally greater than those reported for the reference area. Consequently, statistical comparisons of the Site 3 Pond dioxin-like PCB fish tissue concentrations to the General's Landing dioxin-like PCB fish tissue concentrations were evaluated and are provided in Appendix I. Raw, lipid-normalized, length-normalized, and lipid-length normalized tissue concentrations were compared for individual dioxin-like PCB congeners and dioxin-like TEQs between the Site 3-3rd Battalion pond and General's Landing reference area. Table 19 provides a summary of these statistical comparisons; selected comparisons are presented in Exhibits 5-1, 5-2, and 5-3. Both U.S. EPA Region 4 and Navy's guidance was used to conduct the site versus reference area comparisons. The statistical analyses summarized in Table 19 and plotted in Exhibits 5-1, 5-2, and 5-3 show mixed results when considering whether or not Site 3 dioxin-like PCBs concentrations are statistically greater than those detected in the reference area. Method 2, the hypothesis test, indicates that the length-normalized and lipid-length normalized concentrations of TEQs in the pond fish tissue represent background and are statistically similar. The data comparisons displayed in Appendix I indicate that the statistical comparisons are strongly influenced by one statistical outlier with an elevated concentration (see Exhibit 5-3) and the risk estimate comparisons presented in Figures 11 and 12 indicate that EPCs likely differ by a factor of two or less.

5.7 Uncertainty Analysis

A general discussion of uncertainties associated with the various aspects of the HHRA was presented in the HHRA prepared for the Site 3 RFI/RI (TtNUS, November 1999). Uncertainties specific to this HHRA are presented below.

Mobility of Fish in and out of the Pond

As noted earlier, the 3rd Battalion Pond is connected to the tidal waters on the southwest side of the causeway by two sets of culverts and weirs. The pond receives tidal inflow via these culverts during tides of approximately 8.3 feet or higher. When tides of 8.3 feet or higher occur, fish can move between the pond and the tidal waters southwest of the causeway through the culverts and weirs. MCRD Parris Island's Natural Resource Manager has indicated that smaller bait fish come and go from the pond with the tide. He also indicated that although large organisms such as a 50 pound sea turtle have been observed entering the pond via the culverts, larger fish likely stay in the pond once they enter. As a result, the fish that were caught may or may not have spent their entire life in the pond. If the fish have not been in the pond their entire life, they may have been exposed to contaminants in sediment at other locations, which may cause increased concentrations in the fish tissue. Conversely, if they have been exposed to sediment at other locations with lower concentrations than present in the pond, the concentrations in the fish tissue may be lower than in fish that may have lived their entire life in the pond.

Age and Size of Fish

There was some concern expressed during the development of the sampling plan that if fish older than 8 years were caught, they could have been exposed to pre-IRA sediment (pre-2001). As shown in Table 6, the oldest fish caught were in the 5 to 8 year range, with most of the fish caught being approximately 3 to 4 years old. Consequently, the fish that were caught would not have been exposed to the higher concentrations associated with pre-IRA sediment.

SCDNR sport fishing regulations specify that size limits for red drum are 15 inch minimum and 23 inch maximum. As shown on Table 6, three of the red drum caught in the pond during this investigation exceeded the slot size and, based on SCDNR regulations, could not be consumed legally. These three red drum contained the highest concentrations of mercury and if they were not included in the data set for the 3rd Battalion Pond, risks associated with exposure to mercury in the fish tissue would be within the acceptable range (HIs for all scenarios would be less than or equal to 1). However, risks associated with exposure to dioxin-like PCBs in the fish tissue would still be unacceptable for the civilian recreational users and civilian subsistence fishers.

Quantity and Type of Fish Consumed

One of the main reasons for collecting fish from the 3rd Battalion Pond for evaluation in a HHRA was the uncertainty associated with the frequency that human receptors consume fish collected from the 3rd Battalion Pond. One individual interviewed prior to this investigation indicated that she routinely fishes at the pond and eats fish and/or shrimp from the pond every day, but also indicated that she fished at several other locations on MCRD Parris Island. Other possible contradictions and inconsistencies can be interpreted from the interview, nearly all of which would lead to a reduction in exposure and ultimately a reduction in estimated risks to the receptor. Thus, the regularity of the individual's consumption of fish from the pond is uncertain.

Other uncertainties with the frequency that human receptors consume fish from the 3rd Battalion Pond include the size of the population that consumes fish with the regularity indicated by the individual that was interviewed. The individual interviewed indicated that other people fish at the 3rd Battalion Pond, but not with the same regularity that she did. The amount of fish from the 3rd Battalion Pond that children of school age would consume is also uncertain. Children of school age may eat school lunches which would reduce their exposure to fish from the pond. In addition, children may not eat as much at meal time as an adult. All of these uncertainties would lead to a reduction in exposure and ultimately a reduction in estimated risks to the receptor.

Exposure parameters covering a variety of exposure scenarios were used in the HHRA to provide a range of risks associated with consuming fish from the pond. The consumption rates provided in the Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories.(U.S. EPA, November 2000) are based on a national food consumption survey conducted in 1994, 1995 and 1996. As stated in this guidance document "The purpose of this manual is to provide overall guidance to states on methods for sampling and analyzing contaminants in fish and shellfish tissue that will promote consistency in the data they use to determine the need for fish consumption advisories." The consumption rate used for the recreational users is an estimate of the 90th percentile of recreational and sport fishers, whereas the consumption rate for the subsistence fishers is an estimate of the 99th percentile of subsistence fishers. These consumption rates are based on risk management decision that U.S. EPA has made after evaluating numerous fish consumption surveys (U.S. EPA, November 2000).

The proportion of total fish consumption represented by red drum and mullet by recreational fishers is uncertain. Several local fishers consulted during the fish tissue sampling mobilization, who frequently fish at the 3rd Battalion Pond, reported that red drum caught on hook and line in the pond tend to be too large to legally keep (SCDNR sport fishing regulations specify that size limits for red drum are 15 inch minimum and 23 inch maximum). Thus, red drum from the pond may not be consumed as much as other fish species. Similarly, mullet are not typically caught on hook and line, so mullet may not be consumed as much as other fish species. However, these species were identified by the individual interviewed as examples of fish that she consumes. These species were selected as being representative of all species that exist in the pond, but may not be representative of the receptor's diet.

<u>Sediment to Fish Uptake of Contaminants</u>

Bioaccumulation in fish refers to the uptake of dissolved chemicals from water through the gills and skin as well as uptake from ingested food and incidental ingestion of sediment. The bioaccumulation of chemicals in sediment to fish tissue varies by species, depending on factors such as what the fish eat, how long they live, and sediment characteristics such as carbon content, sulfide content, oxidation-reduction reactions, microbial reactions, and turbulence. Several species of fish are routinely caught and consumed from 3rd Battalion Pond by recreational fishermen and the relationship of Site 3 COPC concentrations in red drum and mullet compared to concentrations in other fish species from the pond is uncertain. As shown by a comparison of the estimated fish tissue concentrations in Table 12 with the actual fish tissue concentrations in Table 11, the relationship of Site 3 sediment concentrations and 3rd Battalion Pond fish tissue concentrations is uncertain. Although 4,4'-DDD was the pesticide detected at the highest concentration in the sediment samples. 4,4'-DDE was the pesticide detected most frequently and at the highest concentrations in the fish tissue samples. Concentrations of 4,4'-DDE in sediment samples were within facility background (see Tables 7, 8, and 10). Concentrations of total DDT in sediment were also less than the facility background concentration (99.8 µg/kg). Therefore, any risks from DDx in fish tissue would be similar to risks posed by facility background concentrations of DDx in sediment. Copper was estimated to be detected in fish tissue at approximately 5.6 mg/kg (Table 12) when in fact it was not detected in any of the fish tissue samples. Mercury was detected in only red drum and not in mullet.

Actual fish tissue data generated in 1991 were used in the 1999 RFI/RI HHRA and the results of that HHRA indicated that, although mercury was identified as a COPC, it was not identified as a risk driver when the risks were calculated. The fish tissue concentration for mercury from the 1991 data was 0.066 mg/kg. The fish tissue concentrations for mercury from the 2009 data ranged from 0.0155 to 0.564 mg/kg. The estimated fish tissue concentration using the 2001 and 2003 sediment data and the Evans and Engel Model was 0.45 mg/kg (based on a maximum sediment concentration 0.2 mg/kg).

Although the form of mercury in the sediment is uncertain and the mechanisms for bioaccumulation of mercury from the sediment to fish tissue are unclear, the form of mercury in the fish tissue is predominantly methyl mercury and was evaluated as such in the HHRA.

National Presence of Mercury in Fish

Two recent studies, one by the U.S. EPA and one by the United States Geological Survey, highlight how widespread mercury pollution has become (primarily as a result of coal-fired power plants). In the U.S. EPA study, mercury was detected in fish from 49 percent of the lakes and reservoirs evaluated in the study at concentrations that exceeded levels that U.S. EPA indicates are safe for people who consume average amounts of fish. PCBs (including the dioxin-like PCBs) were also detected in fish from 17 percent of the lakes and reservoirs at concentrations above recommended levels. The results of the United States Geological Survey indicated that 25 percent of the fish in their survey had mercury at concentrations exceeding levels considered acceptable to the U.S. EPA. In addition, there are fish advisories for mercury in other parts of South Carolina.

Representativeness of 2001 and 2003 Sediment Samples

The locations of the sediment samples collected from the 3rd Battalion Pond in 2001 and 2003 were biased toward areas of potential contamination as a way of determining nature and extent of potentially problematic contaminants. All sediment samples collected in 2001 and 2003 were collected from depositional areas located along the edge of the causeway, which is the source of site-related contaminants at Site 3. Therefore, the samples may reflect "worst case" concentrations. Although this approach is typical of RFI/RI investigations, it can overestimate risks when the resulting data are used to represent contaminant concentrations throughout the site being investigated. Sediment concentrations throughout most of the pond might be much lower than those near the edge of the causeway and fish are exposed to wider areas of the pond and not just the areas next to the causeway. Therefore, the fish could be exposed to sediment containing lower concentrations than found in the sediment adjacent to the causeway.

Aroclor-1254

There is considerable uncertainty in evaluating PCB congeners rather than Aroclor-1254, which was the original COPC. Part of this uncertainty includes the fact that the remedial action and sediment samples were related to Aroclor-1254 and not congeners or more specifically dioxin-like PCB congeners. This adds a degree of uncertainty because specifically linking exposure of Aroclor-1254 in sediment to dioxin-like PCB congeners in fish proves problematic.

PCB Evaluation

The fish tissue samples were not analyzed for non dioxin-like PCBs. However, for the risk assessment the dioxin-like PCBs were used to evaluate risks from PCBs. Therefore, there is some uncertainty in the risk calculations for total PCBs because all PCB congeners were not evaluated. Also the following uncertainties are associated with the evaluation of dioxin-like PCBs.

- As discussed in Section 5.3, dioxin-like PCB congeners were evaluated using toxicity equivalency factors (TEFs) which relate the individual congener concentrations to equivalent concentrations of 2,3,7,8-TCDD as specified in the EPA guidance. PCBs are typically found as mixtures in environmental media, not in the pure congener form, and the toxicity of mixtures is typically different than that of a pure compound.
- EPA considered all cancer studies (which used commercial Aroclor mixtures only) and developed a range of dose-response slope factors (EPA, 1996). The highest PCB slope factor derived by EPA for mixtures is close to 5 orders of magnitude lower than the slope factor for 2,3,7,8-TCDD (used for dioxin-like PCBs),
- The TEF approach for dioxin-like PCB congeners is based on structural-activity/similarity with 2,3,7,8-TCDD congeners. The science is weak and is contrary to the PCB reassessment which recommended a decrease in the slope factor for PCBs (Navy, 2005).

5.8 Summary

This HHRA presents an evaluation of the human health risks resulting from consumption of fish taken from Site 3 (specifically the 3rd Battalion Pond) and the associated reference area; the analysis was based on fish tissue data collected in 2009. The following chemicals were selected at COPCs because the maximum detected concentrations in the fish tissue samples exceeded conservative EPA screening concentrations.

- 4,4’-DDD
- 4,4’-DDE
- 4,4’-DDT
- PCBs (dioxin like)
- Mercury

The following four exposure scenarios were evaluated:

- Military recreational fisherman

- Civilian recreational fisherman
- Civilian subsistence fisherman
- Standard U.S.EPA Region IV default fisherman

These exposure scenarios differ in terms of the amount of fish consumed per meal, and the number of days per year and years per lifetime it is assumed fish taken from the site and its reference area are consumed by a receptor.

Cancer risk estimates developed for recreational-type fishing at Site 3 and its reference area do not exceed the EPA risk management range (10^{-4} to 10^{-6}). However, the cumulative ILCRs for the adult subsistence fisherman taking fish from the reference area (4×10^{-4}) or the 3rd Battalion Pond (7×10^{-4}) do exceed the target risk range. The dioxin-like PCBs and 4,4'-DDE are the major contributors to the ILCRs for the adult subsistence fisherman.

The hazard indices calculated for child recreational fisherman (military or civilian) consuming fish taken from the 3rd Battalion Pond and the reference area were 4 and 2, respectively. The HIs calculated for the child subsistence fisherman were 19 and 9 for the 3rd Battalion Pond and the reference area, respectively. Chemical-specific HIs calculated for the dioxin-like PCBs (the 3rd Battalion Pond and the reference area) and for mercury (the 3rd Battalion Pond, subsistence fisherman only) exceed 1.

The HIs calculated for adult receptors consuming fish taken from the 3rd Battalion Pond exceed 1 only when the subsistence fisherman (HI = 8) or the standard U.S. EPA Region IV Default Fisherman (HI = 3) are evaluated. The primary risk drivers are the dioxin-like PCBs and mercury. The HI calculated for the subsistence fisherman (HI = 4) taking fish from the reference area also exceed 1. The dioxin-like PCBs are the primary risk driver in this case.

The following items should be considered when elevating the results of the risk assessment.

- The statistical analyses summarized in Table 19 and plotted in Exhibits 5-1, 5-2, and 5-3 show mixed results when considering whether or not Site 3 dioxin-like PCBs concentrations are statistically greater than those detected in the reference area.

- Unacceptable noncancer risks were identified for mercury. Three of the red drum caught in the pond during this investigation exceeded the slot size and, based on SCDNR regulations, could not be consumed legally. These three red drum contained the highest concentrations of mercury and if they were not included in the data set for the 3rd Battalion Pond, risks associated with exposure to mercury in the fish tissue would be within the acceptable range (HIs for all scenarios would be less than or equal to 1). However, risks associated with exposure to dioxin-like PCBs in the fish tissue would still be unacceptable for the civilian recreational users and civilian subsistence fishers.

- The subsistence fisher scenario is based on an interview with one fisher person that contained potentially contradictory fish ingestion amounts which prompted the more conservative exposure parameters designed for use in fish consumption advisories. For example it was assumed the subsistence fisher consumed fish from the pond every day for 70 years. The fisher person interviewed prior to this investigation indicated that she routinely fishes at the pond and eats fish and/or shrimp from the pond every day, but also indicated that she fished at several other locations on MCRD Parris Island. Other possible contradictions and inconsistencies can be interpreted from the interview, nearly all of which would lead to a reduction in exposure and ultimately a reduction in estimated risks to the receptor.

- Aroclor-1254 was identified as a Site 3 COPC, not dioxin-like PCBs and sediment concentrations are not available for dioxin-like PCBs for comparison. Pre-remedy sediment sampling results along the Site 3 Causeway showed only two detections of Aroclor-1254 each in 1998 and 1999 from the same area of the Causeway. Therefore, there is uncertainty in whether the dioxin-like PCBs detected in fish tissue are site related..

6.0 ECOLOGICAL RISK ASSESSMENT

Data from sediment samples collected in October 2001 and April 2003 along the Site 3 causeway landfill were used to assess the potential risks of site contamination to aquatic and semi-aquatic ecological receptors. The ecological risk assessment consisted of Steps 1 through 3A of U.S. EPA's 8-step ecological risk assessment process, and was conducted in accordance with U.S. EPA and Navy guidance (U.S. EPA, June 1997; November 2001; Navy, April 1999). Steps 1 through 3A consist of the following:

Step 1	Screening-Level Problem Formulation and Ecological Effects Evaluation
Step 2	Screening-Level Exposure Estimate and Risk Calculation
Step 3a	Refinement of Preliminary Contaminants of Concern

Details regarding the above three steps and the ecological risk assessment process can be found in the references cited above and in the original ecological risk assessment prepared for the Site 3 RFI/RI (TtNUS, November 1999).

Since the results of the ecological risk assessment based on the 2001 and 2003 sediment data indicate minimal risks to benthic invertebrates and upper-level receptors, the fish tissue data collected in 2009 were not evaluated in this ecological risk assessment.

6.1 Screening-Level Problem Formulation and Ecological Effects Evaluation

6.1.1 Habitat Types and Ecological Receptors

Site 3 consists of a causeway constructed across a tidal marsh in the northern portion of MCRD Parris Island. The area south of the causeway is a marshy area with a vast expanse of thickly vegetated cordgrass (*Spartina alterniflora*) intersected by several tidal channels. The area on the northern side of the causeway is essentially a ponded area of open water with scattered areas of cordgrass.

The ponded area north of the causeway occasionally receives tidal inflow via two sets of three culverts. This tidal flow results in saline conditions in the pond, thereby limiting aquatic organisms in the pond to marine species. Fish such as red drum (*Sciaenops ocellatus*), spotted seatrout (*Cynoscion nebulosus*), southern flounder (*Paralichthys lethostigma*), summer flounder (*Paralichthys dentatus*), whiting (*Menticirrhus americanus*), and striped mullet (*Mugil cephalus*) are known to occur on both sides of the causeway. Small schooling fish species such as mud minnows (*Umbra pygmaea*) and mummichogs (*Fundulus heteroclitus*) and a variety of mollusks and crustaceans also occur there.

Several species of animals prey on fish, mollusks, and crustaceans in the marsh and ponded area. Avian predators include ospreys (*Pandion haliaetus*), bald eagles (*Haliaeetus leucocephalus*), and wading birds such as the tricolored heron (*Egretta tricolor*), great blue heron (*Ardea herodias*), green heron (*Butorides striatus*), and snowy egret (*Egretta thula*). An active bald eagle nest is located near the southeastern end of the causeway, and the associated pair of eagles is known to forage in the vicinity of the site. The U.S. Fish and Wildlife Service (USFWS) removed the bald eagle from the federal list of threatened and endangered species effective August 8, 2007. At the federal level, the bald eagle is still protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act (USFWS, July 2007). Various shorebirds and wintering waterfowl forage in the marsh and pond. Mammals that are known or expected to forage along the edge of the marsh and pond include the raccoon (*Procyon lotor*), mink (*Mustela vison*), opossum (*Didelphis virginiana*), marsh rabbit (*Sylvilagus palustris*), and rice rat (*Oryzomys palustris*).

The wood stork (*Mycteria americana*) is the only federally endangered or threatened species known to occur in the vicinity of the Site 3 causeway. Wood storks, which are federally listed as endangered, forage in various locations throughout the Depot, and they are occasionally observed in the ponded area north of the causeway.

Two American alligators (*Alligator mississippiensis*) are frequently observed in the ponded area north of the causeway. Alligators are common in coastal South Carolina and in many parts of their range, and the alligator is technically not threatened or endangered. However, the Endangered Species Act authorizes the treatment of a species as threatened even though it is not otherwise listed as threatened if its physical appearance so closely resembles a species listed as threatened or endangered that enforcement personnel would have substantial difficulty in differentiating between the listed and unlisted species, and the effect of this substantial difficulty is an additional threat to the threatened/endangered species. The American Alligator has this designation due to its similarity of appearance to the endangered American crocodile (*Crocodylus acutus*) and other rare crocodilians.

6.1.2 Contaminant Sources and Migration Pathways

The contaminant source at Site 3 is buried material from historical landfill activities at the site. Remediation activities in 2000 and 2001 have eliminated the surface soil-to-terrestrial receptors pathway and have greatly reduced the possibility of contaminant migration from the landfill into adjacent aquatic habitats. However, residual sediment contamination might exist along the causeway, and residual contaminant migration from the landfill into adjacent surface water and sediment might still be occurring in some portions of the causeway. Therefore, as discussed in Sections 3.1 and 3.2, post-remediation sediment sampling activities were conducted in 2001 and 2003.

6.1.3 Exposure Routes

Benthic organisms (i.e., invertebrate organisms that live on or in sediment) and aquatic organisms in the pond and marsh, and upper trophic level animals such as birds and mammals that forage in the pond and marsh, could be exposed to sediment and surface water contaminants through direct contact with surface water and sediment, incidental ingestion of surface water and sediment, and consumption of contaminated food items. Birds and mammals could incidentally ingest sediment while grooming fur, preening feathers, digging, or feeding on items to which sediment has adhered (such as roots and tubers). Some animals could also come into contact with contaminants in surface water through drinking, although this exposure route represents a negligible portion of total exposure for most receptors (Sample et al., 1996). The salinity of the surface water at Site 3 is approximately 1.8 percent (TtNUS, November 1999), which largely precludes its use as drinking water.

Exposure to contaminants in sediment through dermal contact may occur but is unlikely to represent a major exposure pathway because fur, feathers, and chitinous exoskeletons probably minimize transfer of contaminants across dermal tissue. Absorption of contaminants from the gastrointestinal tract is the primary pathway of intake for upper trophic level receptors.

With the above factors in mind, complete exposure pathways and routes of entry into biota at Site 3 consist of:

- direct contact with sediment and surface water
- incidental ingestion of sediment and surface water
- Ingestion of contaminated food items by upper trophic level animals foraging in the pond and marsh.

As discussed above, ecological receptors in the pond and marsh at Site 3 could be exposed to contaminants in surface water, and thus, surface water represents a technically complete exposure pathway. However, as discussed in Section 2.1.5.3, the evaluation of surface water samples collected during the RFI/RI investigation for Site 3 (TtNUS, November 1999) indicated that ecological risks posed by chemicals in surface water are negligible. Because of this, and since sediments integrate contaminants over time and often indicate a history of contamination to a greater extent than surface water, the MCRD Parris Island Partnering Team decided that sampling activities conducted in 2001 and 2003 would focus on sediment. Therefore, this ecological risk assessment evaluates the sediment samples collected in 2001 and 2003.

The environmental fate, transport, and toxicity of chemicals of concern at Site 3 are presented in Appendix F of the Site 3 RFI/RI Report (TtNUS, November 1999).

6.1.4 Preliminary Assessment and Measurement Endpoints

An assessment endpoint is “an explicit expression of the environmental value that is to be protected,” while a measurement endpoint is “a measurable ecological characteristic that is related to the valued characteristic chosen as the assessment endpoint” (U.S. EPA, June 1997). Measurement endpoints represent the assessment endpoints chosen for a site, and are measures of biological effects (U.S. EPA, June 1997).

U.S. EPA Region 4 has specified that assessment endpoints for the screening-level assessment should be broad and generic. For the Site 3 screening level assessment, the preliminary assessment endpoint is the protection of semi-aquatic wildlife and benthic organisms from adverse effects of chemicals on growth, survival, and reproduction. The preliminary measurement endpoints are chemical concentrations in sediment that are associated with no adverse effects on growth, survival, and reproduction of benthic organisms. The measurement endpoints are represented by sediment “effects values” compiled by U.S. EPA Region 4 (November 2001). The screening level ecological risk assessment for Site 3 used the sediment effects values as ESVs.

The sediment ESVs are based on conservative endpoints and sensitive ecological effects data, and thus, the ESVs represent chemical concentrations associated with a low probability of unacceptable risks to benthic receptors. For this reason, U.S. EPA Region 4 considers the sediment ESVs to be protective of benthic organisms, as well as upper level receptors such as birds and mammals that forage on benthic receptors. In the screening level ecological risk assessment, therefore, a distinction is not made between measurement endpoints associated with direct toxicity to benthic organisms versus measurement endpoints associated with food chain effects.

6.2 Screening-Level Exposure Estimate and Risk Calculation

6.2.1 Approach

Based on conclusions in the RFI/RI (TtNUS, November 1999), and as discussed in Sections 2 and 3 of this report, a total of 15 sediment samples were collected in October 2001 on the pond side (north) of the causeway and five samples were collected on the marsh side (south) of the causeway. Samples collected in the marsh south of the causeway are hereinafter referred to as “marsh” or “marsh-side” samples. The areas on the pond side were identified as Areas 1, 2, 3, and 4 (Figure 3). Three additional sediment samples were collected from Pond Side Area 4 in April 2003 to further define the extent of contamination in that area.

Many benthic organisms are largely sessile, and their movement is limited to a relatively small area. This is especially true for annelid worms, most mollusks, and some crustacean species. With this in mind, the sediment data were organized into five data sets representing the marsh south of the causeway and Areas 1, 2, 3, and 4 north of the causeway, and ecological risks were evaluated for each or the five separate data sets . Larger ranging organisms such as birds and mammals and some crustaceans could be exposed to contaminants from more than one of these five areas. Therefore, ecological risks were also evaluated for a site-wide data set that was comprised of all samples collected in 2001 and 2003.

The screening level risk calculation step compared maximum concentrations of chemicals in sediment to ESVs. The ratio of the maximum concentration to the ESV is called the screening HQ. Analytes with maximum concentrations less than or equal to ESVs (HQ < 1) were dropped from further consideration, while those that exceeded ESVs (HQ > 1), or did not have ESVs, were retained as ecological COPCs. An HQ value greater than 1 indicates that ecological receptors are potentially at risk, and further evaluation or additional data may be necessary to confirm with greater certainty whether ecological receptors are actually at risk, especially since most toxicity benchmarks are developed using conservative exposure assumptions. Chemicals that were retained as COPCs were evaluated in Step 3A so that risk managers can determine if further investigation is warranted.

Total PAH concentrations were calculated as the sum of concentrations of acenaphthene, acenapththylene, anthracene, fluorene, 2-methylnaphthalene, naphthalene, phenanthrene, benzo(a)anthracene, BAP, chrysene, dibenzo(a,h)anthracene, fluoranthene, and pyrene. These 13 PAHs are the same compounds that were summed by MacDonald (1994) to derive the sediment ESVs for total PAHs used by U.S. EPA Region 4. One-half the sample-specific detection limit was used to represent non-detected PAHs when total PAH concentrations were calculated.

Total DDT concentrations were calculated as the sum of concentrations of 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT. One-half the sample-specific detection limit was used to represent non-detected analytes when total DDT concentrations were calculated.

6.2.2 Screening Results

4,4'-DDD, 4,4'-DDE, 4,4'-DDT, total DDT, alpha-chlordane, arsenic, copper, ten individual PAHs, and total PAHs were present in the marsh south of the causeway at concentrations greater than their respective ESVs (Table 20). ESVs were not available for the PAHs benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, and indeno(1,2,3-cd)pyrene, which were detected in most marsh samples (Table 20).

Arsenic and mercury were the only chemicals present at concentrations greater than their respective ESVs in Pond Side Area 1, and an ESV was not available for benzo(b)fluoranthene (Table 21).

Concentrations of arsenic, copper, and lead exceeded ESVs in Pond Side Area 2 (Table 22).

4,4'-DDD, 4,4'-DDT, total DDT, and gamma-chlordane were the only chemicals present at concentrations greater than their respective ESVs in Pond Side Area 3 (Table 23).

In samples collected in 2001 from Pond Side Area 4, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, total DDT, alpha-chlordane, gamma-chlordane, lead, and mercury were present at concentrations greater than their respective ESVs (Table 24). Three sediment samples were collected from Pond Side Area 4 in 2003; in those samples, concentrations of 4,4'-DDD, 4,4'-DDE, and total DDT exceeded ESVs (Table 24). Note in Table 24 that samples collected in 2001 are separated from samples collected in 2003. Although this is not the typical method of data presentation for a given area, the two separate data summaries in Table 24 allow the reader to more easily discern that pesticide concentrations were less in 2003 than in 2001.

Table 25 summarizes the site-wide data set that is comprised of all samples collected in 2001 and 2003. The table is essentially a compilation of Tables 20-24, and the chemicals shown as COPCs in Table 25 are the same as those shown for the five separate data sets in Tables 20-24.

Analytical data for individual sediment samples collected at Site 3 in October 2001 are presented in Table 7 and Appendix C-1. Table 10 and Appendix C-2 provide the analytical results of samples collected in 2003.

6.3 Refinement of Preliminary Chemicals of Potential Concern

At this point, the first two steps of the ecological risk assessment have been completed. The ecological risk assessment process includes a series of scientific/management decision points (SMDPs) (U.S. EPA, June 1997). The first SMDP occurs at the end of Step 2 (Screening Level Exposure Estimate and Risk Calculation), and requires the risk managers to evaluate and approve or redirect the work up to that point and determine whether the risk assessment will continue into Step 3. However, U.S. EPA Region 4 recognizes that most ecological risk assessments will proceed into Step 3, and facilities are encouraged to submit the results of Steps 1-3 as a single deliverable document (U.S.EPA, June 2000). With this in mind, and since the screening level ecological risk assessment indicates a potential for adverse effects, a more thorough assessment is warranted. Therefore, the risk assessment process for Site 3 will proceed into Step 3 (Baseline Risk Assessment Problem Formulation).

6.3.1 General Approach

The baseline ecological risk assessment begins with a more balanced evaluation of the conservativeness inherent in the first two steps of the risk assessment process (U.S. EPA, June 1997; Navy, April 1999). The initial phase of Step 3 is typically known as Step 3A, and consists of a refinement of the conservative exposure assumptions in order to more realistically estimate potential risks to receptors at Site 3. Examples of factors typically considered during Step 3A include toxicological evaluation of COPCs, spatial distribution of contaminants, frequency of detection, background concentrations, and habitat quality (U.S. EPA, June 1997; Navy, April 1999). The objective of the Step 3 refinement is to better define those chemicals that contribute to potentially unacceptable levels of ecological risk, and to identify and eliminate from further consideration those chemicals that were initially selected as COPCs because of the use of very conservative assumptions.

Background sediment samples have been previously collected from Pinckney and Parris Islands as part of RFI/RI activities at MCRD Parris Island. As a result, sediment data are available for use in assessing the extent to which chemical concentrations at Site 3 are due to site-related activities. Details regarding the derivation of background concentrations of inorganics and typical facility pesticide concentrations are provided in Appendix D.

A lines-of-evidence approach (U.S. EPA, June 1997) was used to determine the extent of potential risks posed by COPCs.

6.3.2 Screening and Step 3a Discussion

Potential risks posed by COPCs in each of the five areas sampled (marsh and Areas 1-4) are discussed below.

6.3.2.1 <u>Marsh South of the Causeway</u>

The marsh-side data set is represented by five sediment samples collected along a 2500-foot portion of the southern edge of the causeway (Figure 3).

Sediment PAH concentrations in the five marsh samples tended to be low relative to ESVs except in the duplicate of sample SD-41; this sample was responsible for the maximum concentrations of all detected PAHs (Table 20). PAHs in the original sample SD-41 were either not detected or concentrations were less than ESVs and tended to be an order of magnitude less than in the duplicate (Table 7). The fluoranthene concentration in the duplicate of sample SD-45 (120 µg/kg) slightly exceeded the 113 µg/kg ESV, and the dibenzo(a,h)anthracene concentration in SD-42 (12 µg/kg) exceeded the 6.22 µg/kg ESV (Table 7). Otherwise, all detected PAH concentrations were less than ESVs (Tables 7 and 19). The toxicity of PAHs is often assumed to be additive, so evaluating PAH toxicity in sediment by examining total PAH concentrations is especially useful when, as at Site 3, several PAHs were detected and some PAHs were detected for which ESVs are not available. Total PAH concentrations exceeded the ESV only in the duplicate of sample SD-41, with a screening HQ of 1.2. The total PAH concentration was 216 µg/kg in the original sample and 1,991 µg/kg in the duplicate; the average total PAH value in sample SD-41 was 1,117 µg/kg, which is less than the ESV of 1,684 µg/kg. Detection limits were low for PAH compounds not detected, ranging from 28 to 70 µg/kg (Table 7). Because of the low detected concentrations and because PAHs do not biomagnify in the food chain, the risk posed by PAHs in the marsh is negligible.

Concentrations of 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, total DDT, and alpha-chlordane exceeded their ESV in one or more samples. However, all concentrations of pesticides in the marsh were well below typical facility pesticide concentrations in sediment (Table 7). Thus, concentrations of these pesticides do not appear to be related to landfill activities at Site 3, and instead, are probably reflective of historical use at MCRD Parris Island. Organochlorine pesticides were used at the base for several decades to control insect pests, and were applied in accordance with label instructions.

Arsenic and copper concentrations exceeded their ESVs in two samples (SD-43 and SD-44). Concentrations of arsenic were 9.5 and 13.6 mg/kg in these two samples, compared to an ESV of 7.24 mg/kg and a background value of 12.2 mg/kg. Concentrations of copper in the same two samples were 19.7 and 27.1 mg/kg, compared to an ESV of 18.7 mg/kg, and a background value of 10.1 mg/kg. Maximum screening HQs were relatively low (HQ = 1.9 for arsenic and 1.4 for copper) (Table 20). The arsenic and copper ESVs, as well as most other U.S. EPA Region 4 ESVs, are Threshold Effects Level (TEL) values established by the Florida Department of Environmental Protection (MacDonald, 1994). The TEL is the concentration below which sediment-associated contaminants are not considered to represent significant hazards, the Probable Effects Level (PEL) is the concentration above which adverse effects are probable, and concentrations between the TEL and PEL represent a range in which adverse biological effects are possible, but it is difficult to predict the occurrence and/or severity of effects of concentrations between the TRL and the PEL (MacDonald, 1994). The PEL for arsenic is 41.6 mg/kg and the PEL for copper is 108 mg/kg (MacDonald, 1994). Since the maximum concentrations of arsenic and copper were only slightly greater than their respective TELs and/or background values and were well below PEL values, potential ecological risk posed by these two metals are probably minimal.

In summary, concentrations of PAHs, pesticides, and metals in marsh samples were low relative to ESVs and/or background/typical facility concentrations in sediment. PCBs were not detected in any sample. Based on the analyses of samples collected from the marsh area south of the causeway in October 2001, site-related concentrations of COPCs pose minimal risk to benthic invertebrates.

6.3.2.2 Pond Side Area 1

PAH concentrations were elevated in some sediment samples collected in the vicinity of Pond Side Area 1 prior to the interim response action (TtNUS, November 1999). PAHs were either not detected or were detected at low concentrations in samples collected in October 2001 at Pond Side Area 1, and all detected PAH concentrations were less than their respective ESVs (Tables 7 and 20).

Arsenic and mercury were the only chemicals detected at concentrations greater than their respective ESVs in Pond Side Area 1. Arsenic concentrations exceeded the ESV (7.24 mg/kg) only in SD-47 (7.7 mg/kg), but this maximum concentration was less than the 12.2 mg/kg background concentration for sediment. In view of the background value, the relatively low maximum HQ of 1.1 indicates that any potential risk is not due to landfill-related activities.

Mercury concentrations exceeded the 0.13 mg/kg ESV and the 0.09 mg/kg background value in only one sample (SD-48 at 0.2 mg/kg), with a maximum HQ of 1.5 (Tables 7 and 20). The ESV is a TEL value; the PEL for mercury is 0.696 mg/kg (MacDonald, 1994). Although adverse mercury-related biological effects in the vicinity of SD-48 cannot be ruled out, potential risk is limited to the vicinity of one of four samples, and the concentration in sample SD-48 was less than the PEL. Mercury-related risk in Pond Side Area 1 appears to be minor at worst.

In summary, sediment concentrations of PAHs and most metals in Pond Side Area 1 pose negligible potential risks to benthic invertebrates. Concentrations of mercury pose negligible or minor risk (at worst) to benthic invertebrates in a single sample.

6.3.2.3 Pond Side Area 2

PCB concentrations were elevated in some sediment samples collected in the vicinity of Pond Side Area 2 prior to remediation (TtNUS, November 1999). PCBs were not detected at Pond Side Area 2 in October 2001 samples despite relatively low detection limits (see Appendix C).

Concentrations of arsenic, copper, and lead exceeded ESVs in Area 2 (Table 22). Maximum screening HQs were low, however, for arsenic (HQ = 1.5), copper (HQ = 1.2), and lead (HQ = 1.2) (Table 22). The maximum arsenic concentration (10.5 mg/kg) was less than the 12.2 mg/kg background concentration for sediment (Table 22).

Copper and lead concentrations in Pond Side Area 2 exceeded their ESVs only in sample SD-50. The copper concentration in that sample was 22.5 mg/kg, compared to the PEL of 108 mg/kg, and the lead concentration was 35.8 mg/kg, compared to the PEL of 112 mg/kg (MacDonald, 1994).

In summary, PCBs were not detected in samples collected after the interim response action was completed. Concentrations of metals in sediments from Pond Side Area 2 were low relative to ESVs and/or background/typical facility concentrations in sediment. Although potential site-related risk from copper and lead in the vicinity of SD-50 cannot be totally ruled out, potential risks appear to be minor.

6.3.2.4 Pond Side Area 3

Pesticide concentrations were elevated in some sediment samples collected in the vicinity of Pond Side Area 3 prior to remediation (TtNUS, November 1999). 4,4'-DDD, 4,4'-DDT, total DDT, and gamma-chlordane were detected in October 2001 samples at concentrations greater than their respective ESVs in Pond Side Area 3 (Table 23). Concentrations of 4,4'-DDD and 4,4'-DDT exceeded their respective ESVs only in sample SD-55, while gamma-chlordane exceeded its ESV only in SD-54 (Table 7). Concentrations of all pesticides were well below typical facility pesticide concentrations in sediment (Table 7). Therefore, concentrations of these pesticides do not appear to be related to landfill activities, and are probably reflective of historical use at MCRD Parris Island.

All concentrations of metals in Pond Side Area 3 were less than their respective ESVs (Table 23).

In summary, concentrations of pesticides and metals in sediment from Pond Side Area 3 were low relative to ESVs and/or background/typical facility concentrations in sediment, and pose negligible site-related risks to benthic invertebrates.

6.3.2.5 Pond Side Area 4

Pesticide concentrations were elevated in some sediment samples collected in the vicinity of Pond Side Area 4 prior to remediation (TtNUS, November 1999). In Pond Side Area 4 samples collected in October 2001, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, total DDT, alpha-chlordane, gamma-chlordane, lead, and mercury were present at concentrations greater than their respective ESVs (Table 24).

The 2001 sediment data showed that the extent of pesticide contamination in the vicinity of sample SD-59 had not been determined, and thus, potential risks in Pond Side Area 4 were not totally defined. Subsequently, three additional sediment samples were collected in April 2003 in the vicinity of sample SD-59. In the 2003 samples, 4,4'-DDD, 4,4-DDE, and total DDT were present at concentrations greater than their respective ESVs (Table 24). With the exception of 4,4'-DDD in sample SD-59 in 2001, pesticide concentrations in 2001 and 2003 were less than typical facility pesticide concentrations in sediment at MCRD Parris Island (Tables 7 and 24).

Concentrations of pesticides were lower in sample SD-61 (collected in April 2003) than in sample SD-59 (collected in October 2001), even though the two samples were in extremely close proximity to each other (Figure 6). Sample SD-61 was intended to be co-located with SD-59, and according to a sampling narrative included as Appendix A-2, the pin flag for SD-59 was still present in April 2003, so presumably, the two samples were in fact co-located. The differences in concentrations between sampling events are most notable for 4,4'-DDD, which was measured at 58 µg/kg in 2001 and at 5.7 µg/kg in 2003. Similarly, the concentration of 4,4'-DDE in SD-59 was 26 µg/kg in 2001 and 5.2 µg/kg in SD-61 2003. The lower concentrations in 2003 might be due to build-up of overlying sediment in the approximately 1½ years between sampling events. Another (perhaps more likely) explanation is that the 2001 data represented an extremely small discrete area of contamination. Both of these explanations, however, are speculative. Regardless of the reason for the differences in concentrations between sampling events, the fact remains that the three 2003 samples, which "bounded" sample SD-59, show that concentrations of 4,4'-DDD, 4,4'-DDE, and total DDT in 2003, while greater than the ESV, were well below values that are considered to be typical of past basewide use of these pesticides.

In summary, the concentration of 4,4'-DDD in SD-59, which was collected in 2001, was 58 µg/kg; this exceeded the typical facility concentration in sediment (33.6 µg/kg) of this pesticide at MCRD Parris

Island (Appendix D). Concentrations of pesticides in all other samples collected in 2001 and 2003 in Pond Side Area 4 were well below typical facility concentrations of these pesticides in sediment (Tables 7 and 24). The concentration of 4,4'-DDD in SD-61, which was collected in 2003 and co-located with SD-59, was 5.7 µg/kg (Tables 10 and 24). With these factors in mind, the presence of pesticides at the concentrations measured in 2001 and 2003 is not believed to be due to wastes from the former causeway landfill, and are probably due to historical use at MCRD Parris Island. Any potential risks due to chlordane, DDT, and DDT isomers in Pond Side Area 4 is similar to potential risks posed by these pesticides from previous use throughout the base.

Concentrations of lead exceeded its ESV at Pond Side Area 4 in two of five samples collected in 2001, but the maximum HQ was relatively low (lead HQ = 1.5; Table 24). Lead concentrations in all three 2003 samples were less than the ESV (Table 24). The lead ESV is a TEL value; the PEL for lead is 112 mg/kg (MacDonald, 1994). Although adverse lead-related biological effects in Pond Side Area 4 cannot be ruled out, potential risk is limited to an extremely small area, and overall lead-related risk in Pond Side Area 4 appears to be minor.

Mercury concentrations exceeded the 0.13 mg/kg ESV and the 0.09 mg/kg background value in four of five samples collected in 2001, but the maximum HQ was a relatively low 1.2 (Table 24). The ESV is a TEL value; the PEL for mercury is 0.696 mg/kg (MacDonald, 1994). Mercury was not detected in 2003, but detection limits were 0.19 and 0.2 mg/kg, which were greater than the 0.13 mg/kg ESV. Although adverse mercury-related biological effects in Pond Side Area 4 cannot be ruled out, the relatively low concentrations suggest that potential risk is probably minor.

6.3.2.6 Site-Wide Data Set

As mentioned in Section 6.2.1, mobile organisms could be exposed to contaminants from more than one of the five areas evaluated above. With this in mind, it is appropriate to evaluate potential ecological risks by examining the site-wide data set. Tables 25 and 26 summarize the site-wide data set, which is comprised of all samples collected in 2001 and 2003.

PAHs

PAHs were analyzed in marsh samples and in Pond Side Area 1, resulting in samples from nine locations. PAH concentrations tended to be low relative to ESVs except in the duplicate of sample SD-41; this sample was responsible for the maximum concentrations of all detected PAHs (Table 20). PAHs in the original sample SD-41 were either not detected or concentrations were less than ESVs and tended to be an order of magnitude less than in the duplicate (Table 7). Total PAH concentrations exceeded the 1684 µg/kg ESV only in the duplicate of sample SD-41, with a screening HQ of 1.2. The total PAH concentration was 216 µg/kg in the original sample SD-41 and 1,991 µg/kg in the duplicate; the average total PAH value in sample SD-41 was 1,117 µg/kg, which is less than the ESV. Because of the overall low PAH concentrations, potential risk posed by these compounds is negligible.

Pesticides

Select pesticides (Table 5) were analyzed from 13 sample locations in 2001 and three Pond Side Area 4 locations in 2003, resulting in 16 samples. Alpha-chlordane was detected in two samples and gamma-chlordane was detected in two other samples. Concentrations of alpha- and gamma-chlordane were less than typical facility concentrations in sediment of these pesticides at MCRD Parris Island (Table 26).

4,4'-DDE was detected in 15 of 16 samples, and exceeded its ESV in nine samples. The DDT isomers 4,4'-DDD and 4,4'-DDT were less frequently detected, but concentrations exceeded ESVs in all detected samples (Table 26). Concentrations of 4,4'-DDE, 4,4'-DDT, and total DDT were less than typical facility concentrations for sediment in all samples. Concentrations of 4,4'-DDD exceeded the typical facility concentration for sediment (33.6 µg/kg) in only one of 16 samples (SD-59, at 58 µg/kg). When the location of SD-59 was re-sampled in 2003 (SD-61), the concentration of 4,4'-DDD was 5.7 µg/kg. Mobile receptors such as birds and mammals forage over large areas, and for such receptors, average concentrations provide a reasonable estimate of exposure point concentrations. Although average concentrations of total DDT and DDT isomers exceed ESVs, they are well below typical facility pesticide concentrations in sediment (Table 26). The available data indicate that the presence of pesticides at the concentrations measured in 2001 and 2003 are not due to wastes from the former causeway landfill, but instead are probably due to historical use at MCRD Parris Island.

Metals

Select metals (Table 5) were analyzed from 20 sample locations in 2001 and three Pond Side Area 4 locations in 2003, resulting in 23 samples. Arsenic, copper, lead, and mercury in some samples exceeded their respective ESVs, but maximum HQs were relatively low, ranging from 1.4 to 1.9 (Table 26). The maximum detection of arsenic (13.6 mg/kg) exceeded the background value (12.2 mg/kg), but arsenic concentrations in all other samples were less than the background value (Table 7). Copper concentrations exceeded its ESV and background value in three samples, lead concentrations exceeded its ESV in three samples, and mercury concentrations exceeded its ESV and background value in five samples (Table 26). Average concentrations of arsenic, copper, lead, and mercury were less than their respective background values (Table 26). The data from Site 3 indicate that the presence of these metals at the concentrations measured in 2001 and 2003 are probably not due to landfill wastes and instead are a result of local or regional conditions.

6.4 Uncertainty

General uncertainties involved in ecological risk at Site 3 were discussed in the RFI/RI Report (TtNUS, November 1999) and are not repeated here. Areas of uncertainty specific to this risk assessment are discussed below.

Some chemicals are known to bioaccumulate and biomagnify in the food chain under certain conditions. Sediment COPCs at Site 3 in this category consist of chlordanes, DDT isomers, arsenic, copper, lead, and mercury. Potential risks to representative piscivorous birds and mammals from these COPCs are typically evaluated through food chain modeling. However, with the concurrence of the MCRD Parris Island Partnering Team, food chain modeling was not conducted for ecological COPCs whose average concentration in the site-wide data set is less than the applicable background/typical facility pesticide concentration in sediment. The resulting uncertainty is believed to be minimal, based on a high level of confidence in the site data, the specific ecological COPCs, the nature of those COPCs, and the results of previous food chain modeling conducted in the RFI/RI report (TtNUS, November 1999). Based on these factors, and on remediation activities previously conducted at the site, potential risks via the food chain are negligible, and food chain modeling is not warranted. This conclusion applies only to Site 3 and is not meant to set a precedent at other sites within U.S. EPA Region 4.

The presence of rare animal species at Site 3 introduces some uncertainty to the evaluation of potential risks at the site. Specifically, wood storks (federally listed as endangered) forage in wetlands throughout the Depot, and they are occasionally observed in the ponded area north of the Site 3 causeway. In addition, an active bald eagle nest is located near the southeastern end of the causeway, and the associated pair of eagles is known to forage in the vicinity of the site. Bald eagles are not federally listed as endangered or threatened, but at the federal level, the bald eagle is protected under the Bald and Golden Eagle Protection Act. The extent to which wood storks and bald eagles forage at Site 3 relative to their total foraging area or home range has not been determined, but these species are known to forage over extremely large areas, typically hundreds or thousands of acres. Nevertheless, their foraging at Site 3, even if only occasionally, prompts the need to ensure that a conservative approach is maintained when evaluating risk. Their presence also prompts the need to protect individuals of these species, rather than groups of receptors as is typically done when evaluating ecological risk. Based on the results of the previous ecological risk assessment conducted in the RFI/RI report (TtNUS, November 1999) in which maximum and average COPC concentrations exceeded concentrations present in samples collected in 2001 and 2003, risks via the food chain for such species are not believed to be significant. In addition, any potential pesticide-related risks for such species are similar to those throughout the local region and are not site-related. Therefore, the uncertainty associated with the presence of rare animal species at Site 3 is believed to be minimal.

Most sediment ESVs are not based on toxicity to reptiles and amphibians. As a result, there is uncertainty regarding potential risks to reptiles and amphibians. Although direct conclusions about the potential risks to reptiles and amphibians cannot be made, potential pesticide-related risk for reptiles and amphibians are similar to those throughout the local region and are not site-related. The relatively low concentrations of metals and PAHs suggests that potential risks from these COPCs for reptiles (e.g. alligators and snakes), and amphibians (e.g. frogs), while uncertain, are probably insignificant.

There is uncertainty involving potential cumulative toxicity when concentrations of multiple chemicals exceed their ESVs. For example, two or three isomers of DDT were detected in eight of 16 samples analyzed for pesticides (Tables 7 and 10). One method of evaluating cumulative toxicity of DDT isomers in these samples would be to derive a hazard index for each sample, which is calculated as the sum of HQs of DDT isomers. Another method, which was done in the ecological risk assessment for Site 3, is to derive "total DDT" concentrations, which were calculated as the sum of concentrations of the isomers 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT. For DDT isomers, this accomplishes the same goal as the hazard index approach. Total chlordane concentrations were not calculated, since no sample had more than one detected chlordane isomer. The cumulative toxicity of PAH compounds was evaluated using total PAH concentrations, which were calculated as the sum of concentrations of 13 individual PAH compounds. Hazard indices for metals were not calculated since the toxic mechanisms of metals are complex and it is difficult to ascertain the degree to which metals "produce effects by the same toxic mechanism" (U.S. EPA, June 1997). In summary, the potential for cumulative toxicity exists in some sample locations at Site 3, but based on factors discussed in Section 6.3, PAHs pose negligible risk from cumulative toxicity, and risks from cumulative toxicity of pesticides are not site-related and are similar to those throughout the local region.

Surface water samples have not been collected at Site 3 after the interim remediation conducted in 2000 and 2001. This introduces some uncertainty regarding potential risks to aquatic receptors such as fish; such risks are typically assessed by evaluating surface water data. However, the evaluation of surface water samples collected during the RFI/RI investigation for Site 3 indicated that ecological risks posed by chemicals in surface water are negligible (TtNUS, November 1999). The absence of recent surface water data is not considered to be significant to an evaluation of ecological risks in view of the large sediment data set and the close association of sediment and surface water contaminants.

There is uncertainty regarding the reason for the lower concentrations of lead and pesticides in sample SD-61 (collected in April 2003) than in sample SD-59 (collected in October 2001), even though the two samples were in extremely close proximity to each other. Possible reasons for the difference in concentrations between sampling events were discussed in Section 6.3.2.5, and include build-up of overlying sediment over time, and/or an extremely small discrete area of contamination.

Detection limits for some analytes in some non-detect samples exceeded ESVs (Table 26), which results in uncertainty regarding whether concentrations in the associated samples pose potential risk. In general, however, the detection limits were not appreciably greater than the ESVs, and for pesticides, detection limits were less than typical facility concentrations. Therefore, the resulting uncertainty is believed to be minor.

There is uncertainty regarding how well the basewide background/typical pesticide data set for MCRD Parris Island sediment adequately represents background conditions. However, the MCRD background/typical pesticide data set for sediment is similar to background conditions documented for Port Royal Sound, which abuts Parris Island [see Table 3.2-2 from NOAA (March 1998) contained in Appendix F-4 of the RFI/RI (TtNUS, November 1999]. The similarity of the MCRD and Port Royal Sound data sets lends credence to the representativeness of the former as depicting background conditions.

7.0 SUMMARY AND CONCLUSIONS

7.1 Activities

Sediment samples were collected in 2001 and 2003 to re-characterize the sediment at Site 3 following the completion of an interim response action. Re-characterization of the sediment at Site 3 was identified as a provision of the Interim Soil ROD (TtNUS, September 2000). Twenty sediment samples (15 on the pond side of the Site 3 causeway and 5 on the marsh side of the causeway) were collected in 2001 from depressions (potential accumulation areas for contaminated material) just beyond the edge of the newly installed rip-rap and cover fabric. The 15 samples collected from the pond north of the causeway were collected from four areas identified as representing potentially significant risks during the RFI/RI (TtNUS, November 1999). Detected concentrations in all of the post remedy 2001 samples decreased for all analyzed chemicals when compared to the pre remedy 1998 and 1999 sediment sample results. Three sediment samples were collected in 2003 to further define the extent of contamination in one of the four areas in the pond north of the causeway. The 2003 sediment sample results when compared to the 2001 sediment samples show that pesticide concentrations decreased by an order of magnitude, arsenic concentrations were slightly greater in the 2003 samples, but were still less than the background sediment concentration, and lead concentrations in the 2003 samples also decreased and were similar to the background sediment concentration. Fish tissue samples were collected in October 2009 to evaluate the risks to human receptors that consume fish from the 3rd Battalion Pond.

The results of the HHRA performed for the RFI/RI (TtNUS, November 1999) indicated that direct exposure to sediment by construction workers and maintenance workers did not present unacceptable risks. Because the concentrations detected in the 2001 and 2003 (post-interim response action) data were less than concentrations in the 1998 (pre-interim response action) data, risks to these receptors under current conditions would be less than the pre-interim response action conditions. Consequently, direct exposure to sediment was not re-evaluated in this post-construction HHRA.

Based on the results of a limited interview with a site-specific fisher person (Appendix B), who can be classified as a highly exposed individual (U.S. EPA, 1992) and on regulatory agency comments received on the draft of this Technical Memorandum, fish tissue samples were collected from the 3rd Battalion Pond and from General's Landing Creek (reference location) in October 2009 by TtNUS. The 2001 and 2003 sediment data collected in the 3rd Battalion Pond were used to select sediment COPCs. These included 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, Aroclor-1254, copper, and mercury which were analyzed for in the fish tissue samples collected in October 2009 with the exception of Aroclor-1254. Dioxin-like PCB congeners were analyzed in fish tissue rather than Aroclor-1254 in accordance with U.S. EPA Guidance. The fish tissue sample data was then used to estimate risks to human health through human consumption of the fish by recreational and subsistence fishers.

7.2 Risk Assessment Considerations

7.2.1 Human Health Risk Assessment

The results of the HHRA in the RFI/RI (TtNUS, November 1999) indicated that direct exposure to soil (incidental ingestion and dermal contact) by construction workers and maintenance workers resulted in acceptable risks for both receptors. Review of the RFI/RI surface water data indicates that exposure to surface water does not present risks to human health.

Cancer risk estimates developed for recreational-type fishing at Site 3 and its reference area do not exceed the EPA risk management range (10^{-4} to 10^{-6}). However, the cumulative ILCRs for the adult subsistence fisherman taking fish from the reference area (4×10^{-4}) or the 3rd Battalion Pond (7×10^{-4}) do exceed the target risk range. The dioxin-like PCBs and 4,4'-DDE are the major contributors to the ILCRs for the adult subsistence fisherman.

The hazard indices calculated for child recreational fisherman (military or civilian) consuming fish taken from the 3rd Battalion Pond and the reference area were 4 and 2, respectively. The HIs calculated for the child subsistence fisherman were 19 and 9 for the 3rd Battalion Pond and the reference area, respectively. Chemical-specific HIs calculated for the dioxin-like PCBs (the 3rd Battalion Pond and the reference area) and for mercury (the 3rd Battalion Pond, subsistence fisherman only) exceed 1.

The HIs calculated for adult receptors consuming fish taken from the 3rd Battalion Pond exceed 1 only when the subsistence fisherman (HI = 8) or the standard U.S. EPA Region IV Default Fisherman (HI = 3) are evaluated. The primary risk drivers are the dioxin-like PCBs and mercury. The HI calculated for the subsistence fisherman (HI = 4) taking fish from the reference area also exceeds 1. The dioxin-like PCBs are the primary risk driver in this case.

Although there are calculated unacceptable risks to various receptors, the risks are comparable to, but exceed, those from the reference location. Also, a data review of Site 3 data to the reference area data suggests that, in general, concentrations for the dioxin-like PCBs, mercury, and DDE (the primary risk drivers) do not exceed reference area concentrations by more than a factor of 2. However, a statistical analysis of the two data sets showed mixed results when considering whether or not Site 3 dioxin-like PCB concentrations are statistically greater than those detected in the reference area.

Aroclor-1254 was identified as a Site 3 COPC, not dioxin-like PCBs and sediment concentrations are not available for dioxin-like PCBs for comparison. Pre-remedy sediment sampling results along the Site 3 Causeway showed only two detections of Aroclor-1254 each in 1998 and 1999 from the same area of the Causeway. Therefore, there is uncertainty in whether the dioxin-like PCBs detected in fish tissue are site related.

7.2.2 Ecological Risk Assessment

The results of the ecological risk assessment from the RFI/RI (TtNUS, November 1999) indicated that pesticides, PCBs, PAHs, and several metals in soil may pose risks to benthic (soil) invertebrates. The results also indicated that metals and PCBs may pose risks to upper-level receptors such as birds and mammals. The RFI/RI recommended that a Feasibility Study (FS) or Corrective Measures Study (CMS) be conducted to evaluate capping/covering options for the landfill to protect ecological receptors from exposure to soil and to prevent erosion of soil into the sediment. Review of the RFI/RI (TtNUS, November 1999) surface water data indicates that exposure to surface water does not present risks to ecological receptors that warrant remediation of the surface water.

The sediment data collected in October 2001 and April 2003 were used to assess the potential risks of site contamination to aquatic and semi-aquatic ecological receptors in a Step 1 through 3 ecological risk assessment. The results of the ecological risk assessment indicate that based on the analyses of samples collected from the marsh area south of the causeway, site-related concentrations of COPCs pose minimal risks to benthic invertebrates and upper-level receptors. Based on the analyses of samples collected from Areas 1, 2, and 3 of the pond north of the causeway, site-related concentrations of COPCs also pose minimal risks to benthic invertebrates and upper-level receptors.

The concentrations of 4,4'-DDE and 4,4'-DDD detected in sample PAI-03-SD-59-01 in the 2001 sediment samples collected from Area 4 on the pond side of the causeway pose potential risks to benthic invertebrates. The 4,4'-DDE concentration in this sample is less than the typical facility-wide concentration but the 4,4'-DDD concentration in this sample is greater than the typical facility-wide concentration. Three samples were collected in April 2003 to determine if the elevated 4,4'-DDD and 4,4'-DDE concentrations in sample PAI-03-SD-59-01 were isolated detections. The concentrations of 4,4'-DDD and 4,4'-DDE in the three samples collected in 2003 were an order of magnitude less than the concentrations detected in PAI-03-SD-59-01 and were less than the typical facility-wide concentrations. The results of the 2003 sampling effort indicate that the elevated concentrations in PAI-03-SD-59-01 appear to be an isolated occurrence and the concentrations of pesticides in the Area 4 sediment samples pose negligible site-related risks to benthic invertebrates.

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TABLE 1

1988 INORGANIC SEDIMENT DATA
SITE 3 – CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

Parameter	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6	SS-7	SS-8	U.S. EPA Region 3 RBC[1]	U.S. EPA Region 4 ESV[2]
Inorganics (mg/kg)										
Barium	1.45	2.53	5.88	2.71	3.74	2.38	1.86	3.45	550	NA
Chromium			2.58	2.21	2.43		1.76	1.8	12000	52.3
Lead	0.48	0.98	8.08	6.8	18.8	0.52	4.32	23.9	400[3]	30.2
Mercury	0.45	0.6	0.4	0.3	0.55	0.35	0.35	0.45	2.3[4]	**0.13**
Hexavalent Chromium				0.01			0.01		23	52.3
Selenium					0.16		0.15		39	NA

This table is based on Table 4-8 in the Site 3 RFI/RI (TtNUS, November 1999).

A blank indicates that the chemical was not detected.
NA – Not available.
Samples that exceeded screening levels are shaded.

1 U.S. EPA Region 3 Risk-Based Concentration Table, April 12, 1999. (Cancer benchmark value = 1E-06, HI = 0.1).
2 U.S. EPA Region 4 Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment, November 1995.
3 Office of Solid Waste and Emergency Response (OSWER) Screening Level (U.S. EPA, July 1994).
4 Value is for mercuric chloride.

TABLE 2

SUMMARY OF HUMAN HEALTH CANCER RISKS AND HAZARD INDICES - 1999 RFI/R
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $>10^{-4}$	Chemicals with Cancer Risks $>10^{-5}$	Chemicals with Cancer Risks $>10^{-6}$	Hazard Index	Chemicals with HI > 1
Construction Worker	Soil	Ingestion	1.8E-06	--	--	cPAHs	0.16	--
		Dermal Contact	4.7E-06	--	--	cPAHs	0.06	--
		Total	6.5E-06	--	--	cPAHs	0.22	--
	Groundwater	Dermal Contact	4.0E-08	--	--	--	0.06	--
	Sediment	Ingestion	1.3E-07	--	--	--	0.05	--
		Dermal Contact	2.6E-07	--	--	--	0.01	--
		Total	4.0E-07	--	--	--	0.06	--
	Surface Water	Ingestion	1.4E-07	--	--	--	0.05	--
		Dermal Contact	1.0E-05	--	--	cPAHs	0.09	--
		Total	1.0E-05	--	cPAHs	--	0.14	--
		Total All Media	1.7E-05			Total All Media	0.47	
Maintenance Worker	Soil	Ingestion	3.7E-06	--	--	cPAHs, Arsenic	0.01	--
		Dermal Contact	4.7E-05	--	cPAHs	Arsenic	0.02	--
		Total	5.1E-05	--	cPAHs	Arsenic	0.04	--
	Sediment	Ingestion	8.2E-07	--	--	--	0.01	--
		Dermal Contact	7.9E-06	--	--	cPAHs, Arsenic	0.01	--
		Total	8.7E-06	--	--	cPAHs, Arsenic	0.03	--
		Total All Media	5.9E-05			Total All Media	0.06	
Recreational Users	Fish (Measured Tissue)	Conservative (one meal per day)	5.0E-05	--	Aroclor 1254	Dieldrin, DDE	2.4	Aroclor 1254
		Site-Specific (one meal per week)	3.5E-06	--		Aroclor 1254	0.83	--
	Fish (Calculated Sediment/Surface Water - Maximum Concentration)	Conservative (one meal per day)	1.8E-03	cPAHs, Aroclor 1254, Arsenic	DDE, alpha-chlordane, Aroclor 1260	Carbazole, DDD, DDT, gamma-chlordane	18	Aroclor 1254, Arsenic, Mercury
		Site-Specific (one meal per week)	1.3E-04	--	cPAHs, Aroclor 1254, Arsenic	DDE, Aroclor 1260	6.1	Aroclor 1254, Arsenic, Mercury
	Fish (Calculated Sediment/Surface Water - Average Concentration)	Conservative (one meal per day)	2.0E-04	--	cPAHs, DDE, alpha-chlordane, gamma-chlordane, Aroclor 1254, Aroclor 1260, Arsenic	Carbazole, DDT	2.2	Aroclor 1254
		Site-Specific (one meal per week)	1.4E-05	--	--	cPAHs, DDE, alpha-chlordane, gamma-chlordane, Aroclor 1254, Arsenic	0.76	--

This table is based on Table 6-21 in the Site 3 RFI/RI (TtNUS, November 1999).
CPAHs: Carcinogenic polynuclear aromatic hydrocarbons
Conservative: U.S. EPA Region IV default parameters (see Table 6-18 in the Site 3 RFI/RI)
Site-Specific: Values based on site specific conditions (see Table 6-18 in the Site 3 RFI/RI)

TABLE 3

OCCURRENCE, DISTRIBUTION AND SELECTIONOF CHEMICALS OF POTENTIAL CONCERN - 1998 SEDIMENT DATA
DIRECT CONTACT WITH SEDIMENT
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

Chemical	Minimum[(1)] Concentration	Maximum[(1)] Concentration	Location of Maximum Concentration	Frequency of Detection	Range of Detection Limits	Concentration Used for Screening	Background/ Typical Facility Pesticide Concentration[(2)]	U.S. EPA Region 3 RBC[(3)]	U.S. EPA Region 4 ESV[(4)]
Volatile Organic Compounds (µg/kg)									
2-Butanone	8	61	PAI-03-SD-014-01	6/17	6 - 37	61	NA	4700000 N	NA
Acetone	150 J	170 J	PAI-03-SD-026-01	2/6	39 - 100	170	NA	780000 N	NA
Carbon Disulfide	3 J	40 J	PAI-03-SD-014-01	6/21	6 - 37	40	NA	780000 N	NA
Chloroform	1 J	1 J	PAI-03-SD-016-01	2/21	8 - 38	1	NA	100000 C	NA
Semivolatile Organic Compounds (ug/kg)									
Anthracene	3.7	770	PAI-03-SD-022-01	4/21	2.3 - 260	770	NA	2300000 N	**46.9**
Benzo(a)anthracene	5.1 J	1200	PAI-03-SD-022-01	6/21	5.7 - 650	1200	NA	**870** C	**74.8**
Benzo(a)pyrene	8.1	1200	PAI-03-SD-022-01	6/21	5.7 - 650	1200	NA	**87** C	**88.8**
Benzo(b)fluoranthene	1.8 J	990	PAI-03-SD-022-01	13/21	23 - 260	990	NA	**870** C	**655**
Benzo(g,h,i)perylene	24	570	PAI-03-SD-022-01	2/21	9.2 - 1000	570	NA	160000[(6)] N	655
Benzo(k)fluoranthene[(5)]	3	420	PAI-03-SD-022-01	5/21	2.3 - 260	420	NA	**8700** C	655
Carbazole	570	570	PAI-03-SD-022-01	1/21	440 - 1600	570	NA	32000 C	NA
Chrysene[(5)]	3.2 J	1900	PAI-03-SD-022-01	13/21	60 - 650	1900	NA	**87000** C	**108**
Dibenzofuran	190 J	190 J	PAI-03-SD-022-01	1/21	440 - 1600	190	NA	31000 N	NA
Fluoranthene	15	3500	PAI-03-SD-022-01	9/21	5.7 - 650	3500	NA	310000 N	**113**
Fluorene	13	13	PAI-03-SD-027-01	1/21	11 - 1300	13	NA	310000 N	21.2
Indeno(1,2,3-cd)pyrene[(5)]	5.8 J	660	PAI-03-SD-022-01	6/21	5.7 - 650	660	NA	**870** C	**655**
Phenanthrene	5.8	2400	PAI-03-SD-022-01	9/21	4.6 - 520	2400	NA	160000[(6)] N	**86.7**
Pyrene	11 J	2700	PAI-03-SD-022-01	8/21	11 - 1300	2700	NA	230000 N	**153**
Pesticides/PCBs (µg/kg)									
4,4'-DDD	40 J	290	PAI-03-SD-014-01	2/21	2.3 - 140	290	33.6	2700 C	**1.22**
4,4'-DDE	45 J	45 J	PAI-03-SD-014-01	1/21	2.3 - 140	45	31.6	1900 C	**2.07**
4,4'-DDT	34 J	34 J	PAI-03-SD-021-01	1/21	2.3 - 140	34	34.5	1900 C	**1.19**
alpha-Chlordane	28 J	28 J	PAI-03-SD-028-01	1/21	1.1 - 1400	28	13.9	1800 C	**0.5**
Aroclor-1254	65	250	PAI-03-SD-020-01	3/21	11 - 40	250	NA	320 C	**21.6**
Aroclor-1260	45	70	PAI-03-SD-015-01	2/21	11 - 40	70	NA	320 C	**21.6**
gamma-Chlordane	28 J	28 J	PAI-03-SD-028-01	1/21	1.1 - 1400	28	13.2	1800 C	**0.5**

TABLE 3

OCCURRENCE, DISTRIBUTION AND SELECTIONOF CHEMICALS OF POTENTIAL CONCERN - 1998 SEDIMENT DATA
DIRECT CONTACT WITH SEDIMENT
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

Chemical	Minimum[1] Concentration	Maximum[1] Concentration	Location of Maximum Concentration	Frequency of Detection	Range of Detection Limits	Concentration Used for Screening	Background/ Typical Facility Pesticide Concentration[2]	U.S. EPA Region 3 RBC[3]		U.S. EPA Region 4 ESV[4]
Inorganics (mg/kg)										
Aluminum	1510	29700	PAI-03-SD-026-01	21/21	NA	29700	24284	**7800**	N	NA
Antimony	0.34 J	0.74 J	PAI-03-SD-014-01	3/21	0.19 - 0.66	0.74	ND	3.1	N	2
Arsenic	2.3	19.8	PAI-03-SD-024-01	16/21	0.22 - 0.97	19.8	12.2	**0.43**	C	**7.24**
Barium	3.6	53.8	PAI-03-SD-022-01	16/21	17 - 36.2	53.8	28.0	550	N	NA
Beryllium	0.29	1.4	PAI-03-SD-026-01	11/21	0.02 - 0.46	1.4	0.977	16	N	NA
Cadmium	0.12	0.44	PAI-03-SD-010-01	10/21	0.03 - 0.12	0.44	0.278	7.8	N	0.676
Calcium	408	32800	PAI-03-SD-010-01	21/21	NA	32800	4002	N/A		NA
Chromium	3.3	50.3	PAI-03-SD-026-01	21/21	NA	50.3	35.2	12000[7]	N	52.3[7]
Cobalt	0.11	5.6	PAI-03-SD-026-01	19/21	0.07	5.6	2.63	470	N	NA
Copper	1.8	46.9	PAI-03-SD-020-01	21/21	NA	46.9	10.1	310	N	**18.7**
Iron	1100	28000	PAI-03-SD-024-01	21/21	NA	28000	21450	**2300**	N	NA
Lead	6.4	105	PAI-03-SD-017-01	21/21	NA	105	20.6	400[8]		**30.2**
Magnesium	267	6710	PAI-03-SD-023-01	21/21	NA	6710	6437	N/A		NA
Manganese	9.7	205	PAI-03-SD-026-01	21/21	NA	205	186	1100	N	NA
Mercury	0.05	0.35	PAI-03-SD-028-01	6/21	0.02 - 0.09	0.35	0.09	2.3[9]	N	**0.13**
Nickel	0.42	13.9	PAI-03-SD-020-01	19/21	0.12 - 0.81	13.9	5.95	160	N	15.9
Potassium	170	4570	PAI-03-SD-026-01	21/21	NA	4570	3190	N/A		NA
Selenium	0.32	1.1	PAI-03-SD-028-01	7/21	0.19 - 1	1.1	ND	39	N	NA
Silver	0.13	0.13	PAI-03-SD-020-01	1/21	0.07 - 0.23	0.13	ND	39	N	0.733
Sodium	377	26600	PAI-03-SD-023-01	20/21	1960	26600	19110	N/A		NA
Thallium	0.62	0.62	PAI-03-SD-027-01	1/21	0.18 - 0.89	0.62	0.405	0.55	N	NA
Vanadium	2.6	63.7	PAI-03-SD-026-01	21/21	NA	63.7	49.6	**55**	N	NA
Zinc	5.2	159	PAI-03-SD-020-01	21/21	NA	159	45.0	2300	N	**124**
Cyanide	0.71	0.71	PAI-03-SD-018-01	1/21	0.44 - 1.8	0.71	N/A	160	N	NA

OCCURRENCE, DISTRIBUTION AND SELECTIONOF CHEMICALS OF POTENTIAL CONCERN - 1998 SEDIMENT DATA
DIRECT CONTACT WITH SEDIMENT
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

Chemical	Minimum[1] Concentration	Maximum[1] Concentration	Location of Maximum Concentration	Frequency of Detection	Range of Detection Limits	Concentration Used for Screening	Background/ Typical Facility Pesticide Concentration[2]	U.S. EPA Region 3 RBC[3]	U.S. EPA Region 4 ESV[4]

This table is based on Tables 6-2 and 7-5 in the Site 3 RFI/RI (TtNUS, November 1999).

1 Minimum/maximum detected concentration.
2 The background/typical facility pesticide concentrations represent two times the mean concentrations calculated for each parameter detected in background/typical facility pesticide samples collected at MCRD Parris Island (see Appendix C).
3 U.S. EPA Region 3 Risk-Based Concentration Table, April 12, 1999. (Cancer benchmark value = 1E-06, HI = 0.1).
4 U.S. EPA Region 4 Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment, November 1995.
5 This compound was identified as a COPC because other carcinogenic PAHs exceed screening criteria.
6 No RBC available, naphthalene is used as a surrogate based on similar chemical structures.
7 Hexavalent chromium was not detected in sediment, therefore chromium is evaluated as trivalent chromium.
8 OSWER screening level (U.S. EPA, July 1994).
9 Value is for mercuric chloride.

Definitions:
NA = Not available
J = Estimated Value
C = Carcinogenic
N = Non-carcinogenic

Chemicals identified as COPCs are shaded.

Associated Samples

PAI-03-SD-009-01
PAI-03-SD-010-01
PAI-03-SD-011-01
PAI-03-SD-012-01
PAI-03-SD-012-02
PAI-03-SD-013-01
PAI-03-SD-013-01D
PAI-03-SD-014-01
PAI-03-SD-015-01
PAI-03-SD-016-01
PAI-03-SD-017-01
PAI-03-SD-018-01
PAI-03-SD-019-01
PAI-03-SD-020-01
PAI-03-SD-021-01
PAI-03-SD-022-01
PAI-03-SD-023-01
PAI-03-SD-024-01
PAI-03-SD-025-01
PAI-03-SD-026-01
PAI-03-SD-027-01
PAI-03-SD-028-01

TABLE 4

SUMMARY STATISTICS - 1999 SEDIMENT DATA
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

Parameter	Frequency of Detection	Range of Detected Concentrations	Range of Nondetects	Location of Maximum Positive Detect	Average of Detected Concentrations	Average of All Concentrations[1]
Semivolatile Organics (µg/kg)						
Acenaphthene	1/3	98	120 - 330	PAI-03-SD-29-01-AVG	98.0	108
Anthracene	1/3	4	2.4 - 6.6	PAI-03-SD-29-01-AVG	4.00	2.83
Benzo(a)anthracene	2/3	8.9 - 18	16	PAI-03-SD-29-01-AVG	13.5	11.6
Benzo(a)pyrene	3/3	8.2 - 22	ND	PAI-03-SD-30-01	16.7	16.7
Benzo(b)fluoranthene	3/3	7.8 - 19	ND	PAI-03-SD-30-01	14.8	14.8
Benzo(k)fluoranthene	3/3	4.5 - 10.25	ND	PAI-03-SD-29-01-AVG	7.78	7.78
Chrysene	2/3	6.1 - 13.25	16	PAI-03-SD-29-01-AVG	9.68	9.12
Fluoranthene	3/3	13 - 39	ND	PAI-03-SD-29-01-AVG	24.3	24.3
Indeno(1,2,3-cd)pyrene	2/3	9.9 - 14	59	PAI-03-SD-29-01-AVG	12.0	17.8
Pyrene	2/3	13 - 35.5	33	PAI-03-SD-29-01-AVG	24.3	21.7
Pesticides/PCBs (µg/kg)						
4,4'-DDD	2/6	62 - 70	24 - 28	PAI-03-SD-38-01	66.0	30.7
4,4'-DDE	2/6	60 - 75	24 - 28	PAI-03-SD-36-01	67.5	31.2
Aroclor-1254	2/3	76 - 250	18	PAI-03-SD-34-01-AVG	163	112

This table is based on Table 4-9 from the Site 3 RFI/RI (TtNUS, November 1999).

ND - Not detected.
NA - Not applicable.
1 Average of all concentrations is the arithmetic average where one-half of the detection limit was used for the ND results when calculating the average.

<u>Associated Samples</u>
PAI-03-SD-29-01
PAI-03-SD-30-01
PAI-03-SD-31-01
PAI-03-SD-32-01
PAI-03-SD-33-01
PAI-03-SD-34-01
PAI-03-SD-34-01D
PAI-03-SD-35-01
PAI-03-SD-36-01
PAI-03-SD-37-01
PAI-03-SD-38-01
PAI-03-SD-39-01
PAI-03-SD-40-01

TABLE 5

POST-INTERIM CONSTRUCTION SEDIMENT SAMPLING - 2001 AND 2003
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

Sample Location	Sample Designation	Sample Depth (feet below ground surface)	Sample Analysis			
			TCL PAHs	Select Metals$^{(1)}$	Select Pesticides$^{(2)}$	TCL PCBs
MARSH SIDE						
PAI-03-SD-41	PAI-03-SD-41-01	0 - 0.5	X	X	X	X
PAI-03-SD-42	PAI-03-SD-42-01	0 - 0.5	X	X	X	X
PAI-03-SD-43	PAI-03-SD-43-01	0 - 0.5	X	X	X	X
PAI-03-SD-44	PAI-03-SD-44-01	0 - 0.5	X	X	X	X
PAI-03-SD-45	PAI-03-SD-45-01	0 - 0.5	X	X	X	X
POND SIDE – AREA 1						
PAI-03-SD-46	PAI-03-SD-46-01	0 - 0.5	X	X		
PAI-03-SD-47	PAI-03-SD-47-01	0 - 0.5	X	X		
PAI-03-SD-48	PAI-03-SD-48-01	0 - 0.5	X	X		
PAI-03-SD-49	PAI-03-SD-49-01	0 - 0.5	X	X		
POND SIDE – AREA 2						
PAI-03-SD-50	PAI-03-SD-50-01	0 - 0.5		X		X
PAI-03-SD-51	PAI-03-SD-51-01	0 - 0.5		X		X
PAI-03-SD-52	PAI-03-SD-52-01	0 - 0.5		X		X
POND SIDE – AREA 3						
PAI-03-SD-53	PAI-03-SD-53-01	0 - 0.5		X	X	
PAI-03-SD-54	PAI-03-SD-54-01	0 - 0.5		X	X	
PAI-03-SD-55	PAI-03-SD-55-01	0 - 0.5		X	X	
POND SIDE – AREA 4 (2001 samples)						
PAI-03-SD-56	PAI-03-SD-56-01	0 - 0.5		X	X	
PAI-03-SD-57	PAI-03-SD-57-01	0 - 0.5		X	X	
PAI-03-SD-58	PAI-03-SD-58-01	0 - 0.5		X	X	
PAI-03-SD-59	PAI-03-SD-59-01	0 - 0.5		X	X	
PAI-03-SD-60	PAI-03-SD-60-01	0 - 0.5		X	X	
POND SIDE – AREA 4 (2003 samples)						
PAI-03-SD-61	PAI-03-SD-61-01	0 - 0.5		X$^{(3)}$	X$^{(4)}$	
PAI-03-SD-62	PAI-03-SD-62-01	0 - 0.5		X$^{(3)}$	X$^{(4)}$	
PAI-03-SD-63	PAI-03-SD-63-01	0 - 0.5		X$^{(3)}$	X$^{(4)}$	

1 Metals analysis consisted of arsenic, copper, lead, mercury, and zinc.
2 Pesticide analysis consisted of DDT, DDE, DDD, alpha chlordane, and gamma chlordane.
3 Metals analysis consisted of arsenic, lead, and mercury.
4 Pesticide analysis consisted of DDT, DDE, and DDD.

Analytical methods consisted of the SW-846 methods for PCBs, pesticides, and metals and U.S. EPA 8270C (SIM) or SW846 8310 for PAHs current in 2001/2003.
X indicates that the sample was analyzed for that parameter.

TABLE 6

PHYSICAL CHARACTERISTICS OF FISH COLLECTED OCTOBER 26 TO 31, 2009
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

SAMPLE LOCATION	SAMPLE NUMBER	SAMPLE DATE	FILLET DATE	HOMOGENIZED DATE	FILLET USED	BLENDER ID	SEX	SPECIES	LENGTH (CM)	WEIGHT (G)	AGE (YEARS)[1]
3rd BATTALION POND QUADRANT 1	PAI-03-RD-01-02	20091028	20091029	20091030	LEFT	M1	FEMALE	RED DRUM	48.8	1100	2
	PAI-03-RD-01-03	20091028	20091029	20091030	BOTH	M1	FEMALE	RED DRUM	33.8[2]	382	1
	PAI-03-MU-01-01	20091027	20091028	20091029	BOTH	M1	FEMALE	MULLET	33.9	370	3
	PAI-03-MU-01-04	20091028	20091029	20091030	LEFT	M1	FEMALE	MULLET	48	1050	>4
3rd BATTALION POND QUADRANT 2	PAI-03-RD-02-01	20091026	20091027	20091029	LEFT	M1	FEMALE	RED DRUM	54.3	1353	2
	PAI-03-BD-02-05	20091028	20091029	20091030	LEFT	M1	FEMALE	BLACK DRUM	37	656	2
	PAI-03-BD-02-06	20091028	20091029	20091030	LEFT	M1	FEMALE	BLACK DRUM	39.7	868	2
	PAI-03-BD-02-07	20091028	20091029	20091030	LEFT	M1	MALE	BLACK DRUM	39.2	901	2
	PAI-03-MU-02-02	20091026	20091027	20091029	LEFT	M1	MALE	MULLET	38.3	626	3-4
	PAI-03-MU-02-04	20091028	20091029	20091030	LEFT	M1	MALE	MULLET	47.2	1180	>4
3rd BATTALION POND QUADRANT 3	PAI-03-RD-03-03	20091027	20091028	20091104	LEFT	B1	FEMALE	RED DRUM	82[2]	5800	4-5
	PAI-03-RD-03-04	20091027	20091029	20091104	LEFT	B1	FEMALE	RED DRUM	92.5[2]	7600[3]	5-8
	PAI-03-MU-03-01	20091027	20091028	20091029	BOTH	M1	FEMALE	MULLET	36	489	3
	PAI-03-MU-03-02	20091027	20091028	20091029	LEFT	M1	MALE	MULLET	38.5	591	3-4
3rd BATTALION POND QUADRANT 4	PAI-03-RD-04-01	20091026	20091027	20091104	LEFT	B1	FEMALE	RED DRUM	96[2]	9100[3]	5-8
	PAI-03-RD-DUP-01	20091026	20091027	20091104	RIGHT	B1	FEMALE	RED DRUM	NA	NA	NA
	PAI-03-RD-04-02	20091026	20091027	20091029	BOTH	M1	FEMALE	RED DRUM	32.2[2]	309	1
	PAI-03-MU-04-03	20091026	20091027	20091029	LEFT	M1	MALE	MULLET	41.7	835	>4
	PAI-03-MU-04-04	20091026	20091027	20091029	LEFT	M1	MALE	MULLET	52	1600	>4
	PAI-03-MU-DUP-02	20091026	20091027	20091029	RIGHT	M1	MALE	MULLET	NA	NA	NA
GENERAL'S LANDING CREEK REFERENCE SITE	PAI-03-BD-RF-01	20091029	20091102	20091104	BOTH	M1	FEMALE	BLACK DRUM	27.2[4]	290	1-2
	PAI-03-RD-RF-06	20091030	20091031	20091104	LEFT	B1	FEMALE	RED DRUM	59.3[2]	2050	2
	PAI-03-RD-RF-07	20091031	20091104	20091104	LEFT	M1	FEMALE	RED DRUM	40.5	747	1-2
	PAI-03-RD-DUP-03	20091031	20091104	20091104	RIGHT	M1	FEMALE	RED DRUM	NA	NA	NA
	PAI-03-RD-RF-08	20091031	20091104	20091104	LEFT	M1	FEMALE	RED DRUM	40.1	662	1-2
	PAI-03-RD-RF-09	20091031	20091104	20091104	BOTH	M1	FEMALE	RED DRUM	35.2[2]	406	1
	PAI-03-MU-RF-02	20091029	20091102	20091104	LEFT	M1	MALE	MULLET	37.5	557	3-4
	PAI-03-MU-RF-03	20091029	20091102	20091104	BOTH	M1	MALE	MULLET	32	345	3
	PAI-03-MU-RF-04	20091030	20091031	20091104	LEFT	M1	MALE	MULLET	48.9	1182	>4
	PAI-03-MU-RF-05	20091030	20091031	20091104	LEFT	M1	FEMALE	MULLET	37.7	468	3-4

(1) Ages are estimates based on length-age relationships in the scientific literature (see text).
(2) The length of this fish is outside the SCDNR sport fishing regulations size limits (38.1 cm to 58.4 cm) for red drum.
(3) The weight of this sample exceeded the maximum weight of the available scales (13 pounds [5900 g]). Based on length-to-weight data provided by Wenner (1992), the estimated weight of fish PAI-03-RD-03-04 was approximately 17 pounds (7600 g) and the estimated weight of fish PAI-03-RD-04-01 was approximately 20 pounds (9100 g).
(4) The length of this fish is outside the SCDNR sport fishing regulation size (35.6 cm to 68.6 cm) for black drum.

TABLE 7

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS - 2001 SEDIMENT SAMPLES
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 1 OF 5

PARAMETER	BACKGROUND/ TYPICAL FACILITY PESTICIDE CONCENTRATION(1)	U.S. EPA SCREENING LEVEL FOR RESIDENTIAL SOIL(2)	U.S. EPA REGION 4 ESV(3)	MARSH SIDE SAMPLES								
				PAI-03-SD-41-01 PAI-03-SD-41-01-D 10/16/01	PAI-03-SD-41-01-AVG 10/16/01	PAI-03-SD-41-01-D PAI-03-SD-41-01 10/16/01	PAI-03-SD-42-01 10/16/01	PAI-03-SD-43-01 10/16/01	PAI-03-SD-44-01 10/16/01	PAI-03-SD-45-01 PAI-03-SD-45-01-D 10/16/01	PAI-03-SD-45-01-AVG 10/16/01	PAI-03-SD-45-01-D PAI-03-SD-45-01 10/16/01
Semivolatile Organics (µg/kg)												
ACENAPHTHENE	NA	3,400,000	6.71	28 U	28 J	28 J	26 U	70 UJ	56 U	42 UJ	42 UJ	42 U
ANTHRACENE	NA	17,000,000	46.9	28 UJ	46 J	78 J	26 U	70 UJ	56 U	42 UJ	14 J	14 J
BENZO(A)ANTHRACENE	NA	NA	74.8	24 J	162 J	300 J	66	29 J	12 J	30 J	48.5 J	67
BENZO(A)PYRENE	NA	NA	88.8	11 J	90.5 J	170 J	48	70 UJ	56 U	14 J	22 J	30 J
BENZO(B)FLUORANTHENE	NA	NA	655	19 J	124.5 J	230 J	59	25 J	13 J	25 J	35 J	45
BENZO(G,H,I)PERYLENE	NA	1,700,000(4)	655	28 UJ	42.5 J	71 J	30	70 UJ	56 U	12 J	12 J	42 U
BENZO(K)FLUORANTHENE	NA	NA	655	7 J	44.5 J	82 J	24 J	70 UJ	56 U	42 UJ	14 J	14 J
CHRYSENE	NA	NA	108	12 J	101 J	190 J	34	70 UJ	56 U	17 J	24 J	31 J
DIBENZO(A,H)ANTHRACENE	NA	NA	6.22	28 U	26 J	26 J	12 J	70 UJ	56 U	42 UJ	42 UJ	42 U
FLUORANTHENE	NA	2,300,000	113	42 J	256 J	470 J	91	34 J	21 J	58 J	89 J	120
FLUORENE	NA	2,300,000	21.2	28 U	25.5	37	26 U	70 UJ	56 U	42 UJ	8 J	8 J
INDENO(1,2,3-CD)PYRENE	NA	NA	655	28 UJ	67 J	120 J	46	70 UJ	56 U	42 UJ	18 J	18 J
PHENANTHRENE	NA	1,700,000(4)	86.8	7 J	163.5 J	320 J	23 J	70 UJ	56 U	23 J	54.5 J	86
PYRENE	NA	1,700,000	153	22 J	176 J	330 J	53	21 J	12 J	33 J	45 J	57
TOTAL PAH(5)	NA	NA	1684	216	1117	1991	405	434	325	322	410	518
BAP EQUIVALENTS(6)	NA	15	NA	31	152	262	77	79	62	43	53	64
Pesticides/PCBs (µg/kg)												
4,4'-DDD	33.6	2000	1.22	3.8 J	3.3 J	2.8 J	1.4 J	12 UJ	9.2 U	7.1 U	7.05 U	7.0 U
4,4'-DDE	31.6	1400	2.07	1.8 J	1.6 J	1.4 J	1.5 J	2.9 J	1.7 J	1.6 J	1.65 J	1.7 J
4,4'-DDT	34.5	1700	1.19	12 J	6.55 J	1.1 J	1.5 J	12 UJ	9.2 U	7.1 U	7.05 U	7.0 U
TOTAL DDT(8)	99.8	NA	1.58	17.6	11.45	5.3	4.4	14.9	10.9	8.7	8.7	8.7
ALPHA-CHLORDANE	13.9	1600(10)	0.5(10)	2.4 U	2.4 U	2.4 U	6.6	6.0 UJ	4.7 U	3.6 U	3.6 U	3.6 U
GAMMA-CHLORDANE	13.2	1600(10)	0.5(10)	2.4 U	2.4 U	2.4 U	2.2 U	6.0 UJ	4.7 U	3.6 U	3.6 U	3.6 U
Inorganics (mg/kg)												
ARSENIC	12.2	0.39	7.24	2	1.9	1.8	2.2	9.5 J	13.6	3.8	4.2	4.6
COPPER	10.1	3100	18.7	4.5	4	3.5	5	19.7 J	27.1	9.9	10.55	11.2
LEAD	20.6	400(11)	30.2	7	6.15	5.3	13.2	19.0 J	27.3	12.6	13.4	14.2
MERCURY	0.09	23(12)	0.13	0.01	0.01	0.01	0.04	0.06 J	0.06	0.05	0.05	0.05
ZINC	45	23000	124	12.7	11.2	9.7	20.3	50.3 J	67.7	32.0 J	49.8 J	67.6 J

PCBs were analyzed for but not detected in these 5 samples.

TABLE 7

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS - 2001 SEDIMENT SAMPLES
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

PARAMETER	BACKGROUND/ TYPICAL FACILITY PESTICIDE CONCENTRATION(1)	U.S. EPA SCREENING LEVEL FOR RESIDENTIAL SOIL(2)	U.S. EPA REGION 4 ESV(3)	POND SIDE AREA 1 SAMPLES			
				PAI-03-SD-46-01 10/16/01	PAI-03-SD-47-01 10/16/01	PAI-03-SD-48-01 10/16/01	PAI-03-SD-49-01 10/16/01
Semivolatile Organics (µg/kg)							
ACENAPHTHENE	NA	3,400,000	6.71	28 U	50 U	34 U	28 U
ANTHRACENE	NA	17,000,000	46.9	28 U	50 U	34 U	28 U
BENZO(A)ANTHRACENE	NA	NA	74.8	28 U	18 J	13 J	13 J
BENZO(A)PYRENE	NA	NA	88.8	28 U	50 U	34 U	28 U
BENZO(B)FLUORANTHENE	NA	NA	655	28 U	15 J	10 J	10 J
BENZO(G,H,I)PERYLENE	NA	1,700,000(4)	655	28 U	50 U	34 U	28 U
BENZO(K)FLUORANTHENE	NA	NA	655	28 U	50 U	34 U	28 U
CHRYSENE	NA	NA	108	28 U	11 J	9 J	6 J
DIBENZO(A,H)ANTHRACENE	NA	NA	6.22	28 U	50 U	34 U	28 U
FLUORANTHENE	NA	2,300,000	113	28 U	25 J	28 J	27 J
FLUORENE	NA	2,300,000	21.2	28 U	50 U	34 U	28 U
INDENO(1,2,3-CD)PYRENE	NA	NA	655	28 U	50 U	34 U	28 U
PHENANTHRENE	NA	1,700,000(4)	86.8	28 U	50 U	10 J	12 J
PYRENE	NA	1,700,000	153	28 U	17 J	17 J	14 J
TOTAL PAH(5)	NA	NA	1684	(7)	296	213	340
BAP EQUIVALENTS(6)	NA	15	NA	(7)	56	38	32
Pesticides/PCBs (µg/kg)							
4,4'-DDD	33.6	2000	1.22				
4,4'-DDE	31.6	1400	2.07				
4,4'-DDT	34.5	1700	1.19				
TOTAL DDT(8)	99.8	NA	1.58				
ALPHA-CHLORDANE	13.9	1600(10)	0.5(10)				
GAMMA-CHLORDANE	13.2	1600(10)	0.5(10)				
Inorganics (mg/kg)							
ARSENIC	12.2	0.39	7.24	0.84	7.7	3.5	1
COPPER	10.1	3100	18.7	1.9	10.2	6.2	1.1
LEAD	20.6	400(11)	30.2	4.7	17.7	11.2	4.2
MERCURY	0.09	23(12)	0.13	0.05	0.08	0.2	0.04
ZINC	45	23000	124	7.3	36.1	28.6	6.7

TABLE 7

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS - 2001 SEDIMENT SAMPLES
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

PARAMETER	BACKGROUND/ TYPICAL FACILITY PESTICIDE CONCENTRATION(1)	U.S. EPA REGIONAL SCREENING LEVEL FOR RESIDENTIAL SOIL(2)	U.S. EPA REGION 4 ESV(3)	POND SIDE AREA 2 SAMPLES		
				PAI-03-SD-50-01	PAI-03-SD-51-01	PAI-03-SD-52-01
				10/15/01	10/15/01	10/15/01
Semivolatile Organics (µg/kg)						
ACENAPHTHENE	NA	NA	6.71			
ANTHRACENE	NA	NA	46.9			
BENZO(A)ANTHRACENE	NA	NA	74.8			
BENZO(A)PYRENE	NA	NA	88.8			
BENZO(B)FLUORANTHENE	NA	NA	655			
BENZO(G,H,I)PERYLENE	NA	NA	655			
BENZO(K)FLUORANTHENE	NA	NA	655			
CHRYSENE	NA	NA	108			
DIBENZO(A,H)ANTHRACENE	NA	NA	6.22			
FLUORANTHENE	NA	NA	113			
FLUORENE	NA	NA	21.2			
INDENO(1,2,3-CD)PYRENE	NA	NA	655			
PHENANTHRENE	NA	NA	86.8			
PYRENE	NA	NA	153			
TOTAL PAH(5)	NA	NA	1684			
BAP EQUIVALENTS(6)	NA	15	NA			
Pesticides/PCBs (µg/kg)						
4,4'-DDD	33.6	2000	1.22			
4,4'-DDE	31.6	1400	2.07			
4,4'-DDT	34.5	1700	1.19			
TOTAL DDT(8)	99.8	NA	1.58			
ALPHA-CHLORDANE	13.9	1600(10)	0.5(10)			
GAMMA-CHLORDANE	13.2	1600(10)	0.5(10)			
Inorganics (mg/kg)						
ARSENIC	12.2	0.39	7.24	10.5	5.2	9.3
COPPER	10.1	3100	18.7	22.5	7.7	13.8
LEAD	20.6	400(11)	30.2	35.8	13.3	26.8
MERCURY	0.09	23(12)	0.13	0.12	0.07	0.13
ZINC	45	23000	124	72.5	25.4	48.4

PCBs were analyzed for but not detected in these 3 samples.

TABLE 7

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS - 2001 SEDIMENT SAMPLES
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

PARAMETER	BACKGROUND/ TYPICAL FACILITY PESTICIDE CONCENTRATION(1)	U.S. EPA SCREENING LEVEL FOR RESIDENTIAL SOIL(2)	U.S. EPA REGION 4 ESV(3)	POND SIDE AREA 3 SAMPLES		
				PAI-03-SD-53-01 10/15/01	PAI-03-SD-54-01 10/15/01	PAI-03-SD-55-01 10/15/01
Semivolatile Organics (µg/kg)						
ACENAPHTHENE	NA	NA	6.71			
ANTHRACENE	NA	NA	46.9			
BENZO(A)ANTHRACENE	NA	NA	74.8			
BENZO(A)PYRENE	NA	NA	88.8			
BENZO(B)FLUORANTHENE	NA	NA	655			
BENZO(G,H,I)PERYLENE	NA	NA	655			
BENZO(K)FLUORANTHENE	NA	NA	655			
CHRYSENE	NA	NA	108			
DIBENZO(A,H)ANTHRACENE	NA	NA	6.22			
FLUORANTHENE	NA	NA	113			
FLUORENE	NA	NA	21.2			
INDENO(1,2,3-CD)PYRENE	NA	NA	655			
PHENANTHRENE	NA	NA	86.8			
PYRENE	NA	NA	153			
TOTAL PAH(5)	NA	NA	1684			
BAP EQUIVALENTS(6)	NA	15	NA			
Pesticides/PCBs (µg/kg)						
4,4'-DDD	33.6	2000	1.22	5.7 U	5.5 U	2.7 J
4,4'-DDE	31.6	1400	2.07	5.7 U	1.2 J	1.7 J
4,4'-DDT	34.5	1700	1.19	5.7 U	5.5 U	1.3 J
TOTAL DDT(8)	99.8	NA	1.58	(9)	6.7	5.7
ALPHA-CHLORDANE	13.9	1600(10)	0.5(10)	2.9 U	2.8 U	3.2 U
GAMMA-CHLORDANE	13.2	1600(10)	0.5(10)	2.9 U	3.4	3.2 U
Inorganics (mg/kg)						
ARSENIC	12.2	0.39	7.24	2.1	3.6	5.1
COPPER	10.1	3100	18.7	3.2	4.1	5.6
LEAD	20.6	400(11)	30.2	9.9	10	13.7
MERCURY	0.09	23(12)	0.13	0.09	0.04	0.05
ZINC	45	23000	124	16.5	20.4	25.9

TABLE 7

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS - 2001 SEDIMENT SAMPLES
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

PARAMETER	BACKGROUND/ TYPICAL FACILITY PESTICIDE CONCENTRATION(1)	U.S. EPA SCREENING LEVEL FOR RESIDENTIAL SOIL(2)	U.S. EPA REGION 4 ESV(3)	POND SIDE AREA 4 SAMPLES				
				PAI-03-SD-56-01	PAI-03-SD-57-01	PAI-03-SD-58-01	PAI-03-SD-59-01	PAI-03-SD-60-01
				10/16/01	10/16/01	10/16/01	10/16/01	10/16/01
Semivolatile Organics (µg/kg)								
ACENAPHTHENE	NA	NA	6.71					
ANTHRACENE	NA	NA	46.9					
BENZO(A)ANTHRACENE	NA	NA	74.8					
BENZO(A)PYRENE	NA	NA	88.8					
BENZO(B)FLUORANTHENE	NA	NA	655					
BENZO(G,H,I)PERYLENE	NA	NA	655					
BENZO(K)FLUORANTHENE	NA	NA	655					
CHRYSENE	NA	NA	108					
DIBENZO(A,H)ANTHRACENE	NA	NA	6.22					
FLUORANTHENE	NA	NA	113					
FLUORENE	NA	NA	21.2					
INDENO(1,2,3-CD)PYRENE	NA	NA	655					
PHENANTHRENE	NA	NA	86.8					
PYRENE	NA	NA	153					
TOTAL PAH(5)	NA	NA	1684					
BAP EQUIVALENTS(6)	NA	15	NA					
Pesticides/PCBs (µg/kg)								
4,4'-DDD	33.6	2000	1.22	2.1 J	7.8 U	19 U	58	12 J
4,4'-DDE	31.6	1400	2.07	2.8 J	4.2 J	4.8 J	26	12 J
4,4'-DDT	34.5	1700	1.19	4.3 U	7.8 U	19 U	3.8 J	3.8 J
TOTAL DDT(8)	99.8	NA	1.58	7.05	12	23.8	87.8	27.8
ALPHA-CHLORDANE	13.9	1600(10)	0.5(10)	2.2 U	4.0 U	9.6 U	2.8 J	5.8 UJ
GAMMA-CHLORDANE	13.2	1600(10)	0.5(10)	2.2 U	2.0 J	9.6 U	3.8 U	5.8 UJ
Inorganics (mg/kg)								
ARSENIC	12.2	0.39	7.24	1.9	1.6	4.5 J	2.3	3.5 J
COPPER	10.1	3100	18.7	4.2	6.8	7.6 J	7.6	13.2 J
LEAD	20.6	400(11)	30.2	23.2	14.6	17.2 J	36.4	44.9 J
MERCURY	0.09	23(12)	0.13	0.04	0.16	0.16 J	0.15	0.14 J
ZINC	45	23000	124	49.4	65.4	93.3 J	38.1	78.0 J

1 The background/typical facility pesticide concentrations represent two times the mean concentrations calculated for each parameter detected in background/typical facility pesticide samples collected at MCRD Parris Island (see Appendix D).
2 Regional Screening Levels for Chemicals at Superfund Sites (U.S. EPA, May 2009).
3 U.S. EPA Region 4 Ecological Screening Table (U.S. EPA, December 1998).
4 Value is for pyrene.
5 Total PAHs = Low Molecular Weight PAHs + High Molecular Weight PAHs.
• Low Molecular Weight PAHs = 2-methylnaphthalene + acenaphthene + acenaphthylene + anthracene + fluorene + naphthalene + phenanthrene
• High Molecular Weight PAHs = benzo(a)anthracene + benzo(a)pyrene + chrysene + dibenzo(a,h)anthracene + fluoranthene + pyrene.
• One-half the detection limits were used for nondetected PAHs to calculate total PAHs and BAP Equivalents.
6 BAP Equivalents = benzo(a)anthracene (0.1) + benzo(a)pyrene (1.0) + benzo(b)fluoranthene (0.1) + benzo(k)fluoranthene (0.01) + chrysene (0.001) + dibenzo(a,h)anthracene (1.0) + indeno(1,2,3-cd)pyrene (0.1).
7 Not calculated - PAHs were not detected in this sample.
8 Total DDT includes the total of concentrations reported for 4,4'-DDD, 4,4'-DDE, and 4,4-DDT. One-half the detection limits were used for nondetected paramaters to calculate total DDT.
9 Not calculated - 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT were not detected in this sample.
10 Based on total chlordane.
11 Office of Solid Waste and Emergency Response (OSWER) Soil Screening Level for Residential Land Use (U.S. EPA, July 1994).
12 Value is for mecuric chloride.

NA - Not applicable.
U - Not detected.
J - Estimated value.
Blank space - not analyzed.

TABLE 8

SUMMARY FREQUENCY OF DETECTION - 2001 SEDIMENT
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

PARAMETER	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATIONS	RANGE OF NONDETECTS	LOCATION OF MAXIMUM POSITIVE DETECTION	AVERAGE OF DETECTED CONCENTRATIONS	AVERAGE OF ALL CONCENTRATIONS	BACKGROUND/ TYPICAL FACILITY PESTICIDE CONCENTRATION(1)	U.S. EPA SCREENING LEVEL FOR RESIDENTIAL SOIL(2)	U.S. EPA REGION 4 ESV(3)
Semivolatile Organics (µg/kg)									
Acenaphthene	1/9	28	26 - 70	PAI-03-SD-41D	28	22	NA	3,400,000	6.71
Anthracene	2/9	14 - 78	26 - 70	PAI-03-SD-41D	30	23	NA	17,000,000	46.9
Benzo(a)anthracene	8/9	12 - 300	28	PAI-03-SD-41D	45	42	NA	NA	74.8
Benzo(a)pyrene	3/9	11 - 170	28 - 70	PAI-03-SD-41D	54	33	NA	NA	88.8
Benzo(b)fluoranthene	8/9	10 - 230	28	PAI-03-SD-41D	36	34	NA	NA	655
Benzo(g,h,i)perylene	3/9	12 - 71	28 - 70	PAI-03-SD-41D	28	24	NA	1,700,000(4)	655
Benzo(k)fluoranthene	3/9	7 - 82	28 - 70	PAI-03-SD-41D	28	24	NA	NA	655
Chrysene	6/9	6 - 190	28 - 70	PAI-03-SD-41D	31	29	NA	NA	108
Dibenzo(a,h)anthracene	2/9	12 - 26	28 - 70	PAI-03-SD-41D	19	21	NA	NA	6.22
Fluoranthene	8/9	21 - 470	28	PAI-03-SD-41D	71	65	NA	2,300,000	113
Fluorene	2/9	8 - 37	26 - 70	PAI-03-SD-41D	17	20	NA	2,300,000	21.2
Indeno(1,2,3-cd)pyrene	3/9	18 - 120	28 - 70	PAI-03-SD-41D	44	29	NA	NA	655
Phenanthrene	5/9	7 - 320	28 - 70	PAI-03-SD-41D	53	41	NA	1,700,000(4)	86.8
Pyrene	8/9	12 - 330	28	PAI-03-SD-41D	44	41	NA	1,700,000	153
Total PAHs(5)	8/9	213 - 1991	NA(7)	PAI-03-SD-41D	440	NA(7)	NA	NA	1684
BAP Equivalents(6)	8/9	31 - 262	NA(7)	PAI-03-SD-41D	69	NA(7)	NA	15	NA
Pesticides/PCBs (µg/kg)									
4,4'-DDD	6/13	1.4 - 58	5.5 - 19	PAI-03-SD-59	13	8.7	33.6	2000	1.22
4,4'-DDE	12/13	1.2 - 26	5.7	PAI-03-SD-59	5.2	5.0	31.6	1400	2.07
4,4'-DDT	5/13	1.1 - 12	4.3 - 19	PAI-03-SD-41	3.4	4.0	34.5	1700	1.19
Total DDT(8)	12/13	4.4 - 87.8	NA(9)	PAI-03-SD-59	17.6	NA(9)	99.8	NA	1.58
Alpha-Chlordane	2/13	2.8 - 6.6	2.2 - 9.6	PAI-03-SD-42	4.7	2.5	13.9	1600(10)	0.5(10)
Gamma-Chlordane	2/13	2 - 3.4	2.2 - 9.6	PAI-03-SD-54	2.7	2.2	13.2	1600(10)	0.5(10)
Inorganics (mg/kg)									
Arsenic	20/20	0.84 - 13.6	0	PAI-03-SD-44-01	4.7	4.7	12.2	0.39	7.24
Copper	20/20	1.1 - 27.1	0	PAI-03-SD-44-01	9.1	9.1	10.1	3100	18.7
Lead	20/20	4.2 - 44.9	0	PAI-03-SD-60-01	18	18	20.6	400(11)	30.2
Mercury	20/20	0.01 - 0.2	0	PAI-03-SD-48-01	0.09	0.09	0.09	23(12)	0.13
Zinc	20/20	6.7 - 93.3	0	PAI-03-SD-58-01	41	41	45	23000	124

1 The background/typical facility pesticide concentrations represent two times the mean concentrations calculated for each parameter detected in background/typical facility pesticide samples collected at MCRD Parris Island (see Appendix D).
2 Regional Screening Levels for Chemicals at Superfund Sites (U.S. EPA, May 2009).
3 U.S. EPA Region 4 Ecological Screening Table (U.S. EPA, December 1998).
4 Value is for pyrene.
5 Total PAHs = Low Molecular Weight PAHs + High Molecular Weight PAHs.
• Low Molecular Weight PAHs = 2-methylnaphthalene + acenaphthene + acenaphthylene + anthracene + fluorene + naphthalene + phenanthrene
• High Molecular Weight PAHs = benzo(a)anthracene + benzo(a)pyrene + chrysene + dibenzo(a,h)anthracene + fluoranthene + pyrene.
• One-half the detection limits were used for nondetected PAHs to calculate total PAHs and BAP Equivalents.
6 BAP Equivalents = benzo(a)anthracene (0.1) + benzo(a)pyrene (1.0) + benzo(b)fluoranthene (0.1) + benzo(k)fluoranthene (0.01) + chrysene (0.001) + dibenzo(a,h)anthracene (1.0) + indeno(1,2,3-cd)pyrene (0.1).
7 NA - Not applicable. This value was not calculated because no PAHs were detected in sample PAI-03-SD-46-01.
8 Total DDT includes the total of concentrations reported for 4,4'-DDD, 4,4'-DDE, and 4,4-DDT. One-half the detection limits were used for nondetected paramaters to calculate total DDT.
9 NA - Not applicable. This value was not calculated because DDD, DDE, and DDT were not detected in sample PAI-03-SD-53-01.
10 Based on total chlordane.
11 Office of Solid Waste and Emergency Response (OSWER) Soil Screening Level for Residential Land Use (U.S. EPA, July 1994).
12 Value is for mecuric chloride.

TABLE 8

SUMMARY FREQUENCY OF DETECTION - 2001 SEDIMENT
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

NA - Not applicable.
J - Estimaed value.

Associated Samples:

Marsh Area	Pond Area 1	Pond Area 2	Pond Area 3	Pond Area 4
PAI-03-SD-41-01	PAI-03-SD-46-01	PAI-03-SD-50-01	PAI-03-SD-53-01	PAI-03-SD-56-01
PAI-03-SD-41-01-AVG	PAI-03-SD-47-01	PAI-03-SD-51-01	PAI-03-SD-54-01	PAI-03-SD-57-01
PAI-03-SD-41-01-D	PAI-03-SD-48-01	PAI-03-SD-52-01	PAI-03-SD-55-01	PAI-03-SD-58-01
PAI-03-SD-42-01	PAI-03-SD-49-01			PAI-03-SD-59-01
PAI-03-SD-43-01				PAI-03-SD-60-01
PAI-03-SD-44-01				
PAI-03-SD-45-01				
PAI-03-SD-45-01-AVG				
PAI-03-SD-45-01-D				

TABLE 9

COMPARISON OF 1998 AND 2001 MARSH SIDE DATA
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

PARAMETER	FREQUENCY OF DETECTION 2001	FREQUENCY OF DETECTION 1998	RANGE OF DETECTED CONCENTRATIONS 2001	RANGE OF DETECTED CONCENTRATIONS 1998	AVERAGE OF ALL CONCENTRATIONS(1) 2001	AVERAGE OF ALL CONCENTRATIONS(2) 1998	BACKGROUND/ TYPICAL FACILITY PESTICIDE CONCENTRATION(3)	U.S. EPA SCREENING LEVEL FOR RESIDENTIAL SOIL(4)	U.S. EPA REGION 4 ESV(5)
Semivolatile Organic (μg/kg)									
BAP - equivalents	5/5	-	62-262	-	85	-	-	15	-
Total PAHs	5/5	-	325-1991	-	538	-	-	-	1684
Pesticides/PCBs (μg/kg)									
4,4'-DDD	2/5	0/5	1.4 - 3.8	-	1.5	NA	33.6	2000	1.22
4,4'-DDE	5/5	0/5	1.4 - 2.9	-	1.9	NA	31.6	1400	2.07
4,4'-DDT	2/5	1/5	1.1 - 12	34	2.1	12.4	34.5	1700	1.19
Alpha-Chlordane	1/5	0/5	6.6	-	1.7	NA	13.9	1600(6)	0.5(6)
Arochlor-1254	0/5	1/5	-	97	NA	25.5	-	220	NA
Arochlor-1260	0/5	1/5	-	45	NA	13.1	-	220	NA
Gamma-Chlordane	0/5	0/5	-	-	NA	NA	13.2	1600(6)	0.5(6)
Inorganics (mg/kg)									
Arsenic	5/5	5/5	1.8 - 13.6	2.6 - 8.4	6.3	5.5	12.2	0.39	7.24
Copper	5/5	5/5	3.5 - 27.1	3 - 20.5	13.3	11.9	10.1	3100	18.7
Lead	5/5	5/5	5.3 - 27.3	10.6 - 44.0	15.8	22.2	20.6	400(7)	30.2
Mercury	5/5	0/5	0.01 - 0.06	-	0.04	NA	0.09	23(8)	0.13
Zinc	5/5	5/5	9.7 - 67.7	18.2 - 54.1	39.9	32.1	45	23000	124

Associated Samples:

1998		**2001**		
PAI-03-SD-09-01	PAI-03-SD-13-01	PAI-03-SD-41-01	PAI-03-SD-42-01	PAI-03-SD-45-01
PAI-03-SD-11-01	PAI-03-SD-21-01	PAI-03-SD-41-01-AVG	PAI-03-SD-43-01	PAI-03-SD-45-01-AVG
PAI-03-SD-12-01		PAI-03-SD-41-01-D	PAI-03-SD-44-01	PAI-03-SD-45-01-D

1 Katahdin Analytical Services, Inc. soil Method Detection Limits (MDLs) were used to calculate detection limits for pesticides and PCBs, which were not detected in sediment. If a pesticide or PCB was not detected, one-half the laboratory MDL, adjusting for moisture, was used.
2 RECRA LABNET soil MDLs were used to calculate detection limits for pesticides and PCBs, which were not detected in sediment. If a pesticide or PCB was not detected, one-half the laboratory MDL, adjusting for moisture, was used. A 5:1 dilution factor was accounted for on pesticide results from samples PAI-03-SD-09, -11, -12, -13, and -21.
3 The background/typical facility pesticide concentrations represent two times the mean concentrations calculated for each parameter detected in background/typical facility pesticide samples collected at MCRD Parris Island (see Appendix D).
4 Regional Screening Levels for Chemicals at Superfund Sites (U.S. EPA, May 2009).
5 U.S. EPA Region 4 Ecological Screening Table (U.S. EPA, December 1998).
6 Based on total chlordane.
7 Office of Solid Waste and Emergency Response (OSWER) Soil Screening Level for Residential Land Use (U.S. EPA, July 1994).
8 Value is for mecuric chloride.

NA: Not applicable because all samples in the area were non-detect for this chemical.

TABLE 10

SUMMARY OF SEDIMENT ANALYTICAL RESULTS - 2003 SEDIMENT SAMPLES
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

PARAMETER	BACKGROUND/ TYPICAL FACILITY PESTICIDE CONCENTRATION(1)	U.S. EPA SCREENING LEVEL FOR RESIDENTIAL SOIL(2)	U.S. EPA REGION 4 ESV(3)	PAI-03-SD-61-01	PAI-03-SD-62-01	PAI-03-SD-63-01
Pesticides/PCBs (µg/kg)						
4,4'-DDD	33.6	2000	1.22	5.7 J	4.9 J	12 U
4,4'-DDE	31.6	1400	2.07	5.2 J	2.8 J	2.5 J
4,4'-DDT	34.5	1700	1.19	13 U	16 U	12 U
Total DDT(4)	99.8	NA	1.58	17.4	15.7	14.5
2,4'-DDD	NA	NA	NA	13 U	16 U	12 U
2,4'-DDE	NA	NA	NA	5.2 U	6.2 U	4.7 U
2,4'-DDT	NA	NA	NA	13 U	16 U	12 U
Inorganics (mg/kg)						
ARSENIC	12.2	0.39	7.24	5.3 J	5.3 J	6.4 J
LEAD	20.6	400(5)	30.2	13 J	18 J	22 J
MERCURY	0.09	23(6)	0.13	0.2 U	0.2 U	0.19 U
Miscellaneous Parameters						
TOTAL ORGANIC CARBON (mg/kg)	NA	NA	NA	6700	11,000	15,000

NA - Not Available.
U - Not detected.
J - Estimated value.

1 The background/typical facility pesticide concentrations represent two times the mean concentrations calculated for each parameter detected in background/typical facility pesticide samples collected at MCRD Parris Island (see Appendix D).
2 Regional Screening Levels for Chemicals at Superfund Sites (U.S. EPA, May 2009).
3 U.S. EPA Region 4 Ecological Screening Table (U.S. EPA, December 1998).
4 Total DDT includes the total of concentrations reported for 4,4'-DDD, 4,4'-DDE, and 4,4-DDT. One-half the detection limits were used for nondetected paramaters to calculate total DDT.
5 Office of Solid Waste and Emergency Response (OSWER) Soil Screening Level for Residential Land Use (U.S. EPA, July 1994).
6 Value is for mecuric chloride.

TABLE 11

SUMMARY OF FISH TISSUE DATA - OCTOBER 2009
SITE 3 - CAUSEWAY POND
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 1 OF 2

CAS NO.	PARAMETER	3RD BATTALION POND FISH TISSUE DATA							
		FREQUENCY OF DETECTIONS	MINIMUM CONCENTRATION	MAXIMUM CONCENTRATION	LOCATION OF MAXIMUM CONCENTRATION	SAMPLE CONTAINING MAXIMUM CONCENTRATION	MINIMUM NON-DETECT	MAXIMUM NON-DETECT	AVERAGE OF POSITIVE CONCENTRATIONS
	METALS (MG/KG)								
7440-50-8	COPPER	0/18	---	---	---	---	0.22	0.71	---
7439-97-6	MERCURY	7/18	0.0155	0.564	03BATPOND-Q4	PAI-03-RD-04-01	0.0019	0.106	0.172
	PCB CONGENERS (NG/KG)								
32598-14-4	PCB-105	18/18	34.6	1010	03BATPOND-Q4	PAI-03-MU-04-04	---	---	327
74472-37-0	PCB-114	8/18	10.64	61.4	03BATPOND-Q4	PAI-03-MU-04-04-D	3.54	11.3	34.8
31508-00-6	PCB-118	18/18	126	5080 J	03BATPOND-Q4	PAI-03-MU-04-04	---	---	1545
65510-44-3	PCB-123	11/18	4.28 J	57.5 J	03BATPOND-Q4	PAI-03-MU-04-04	3.34	19.2	22.2
57465-28-8	PCB-126	4/18	15.6	61.3 J	03BATPOND-Q4	PAI-03-MU-04-04	4.58	28.7	35.6
--	PCB-156/157	18/18	12.8	731	03BATPOND-Q4	PAI-03-MU-04-04	---	---	176
52663-72-6	PCB-167	18/18	6.47	572 J	03BATPOND-Q4	PAI-03-MU-04-04	---	---	134
32774-16-6	PCB-169	1/18	19.9 J	19.9 J	03BATPOND-Q4	PAI-03-MU-04-04	6.24	48.9	19.9
39635-31-9	PCB-189	8/18	9.39 J	131	03BATPOND-Q4	PAI-03-MU-04-04-D	2.38	4.7	52.8
32598-13-3	PCB-77	11/18	7.21	101	03BATPOND-Q4	PAI-03-MU-04-03	3.47	9.47	50.8
70362-50-4	PCB-81	1/18	7.1 J	7.1 J	03BATPOND-Q4	PAI-03-MU-04-04-D	3.5	11.8	7.10
--	PCB TEQ	18/18	0.672	6.97	03BATPOND-Q4	PAI-03-MU-04-04	---	---	1.95
--	TOTAL DIOXIN-LIKE PCBs	18/18	180	7807	03BATPOND-Q4	PAI-03-MU-04-04	---	---	2275
	PESTICIDES (UG/KG)								
72-54-8	4,4'-DDD	10/18	2.4 J	14 J	03BATPOND-Q4	PAI-03-MU-04-03	0.34	0.42	6.00
72-55-9	4,4'-DDE	18/18	1.5 J	71 J	03BATPOND-Q4	PAI-03-MU-04-04	---	---	17.5
50-29-3	4,4'-DDT	13/18	1.6 J	7.2 J	03BATPOND-Q4	PAI-03-MU-04-04	0.34	4.2	3.45
	MISCELLANEOUS PARAMETERS (%)								
--	LIPIDS	18/18	0.15	7.8	03BATPOND-Q4	PAI-03-MU-04-03	---	---	2.52
--	TOTAL SOLIDS	18/18	20	28	03BATPOND-Q2	PAI-03-MU-02-02, PAI-03-MU-04-03, PAI-03-MU-04-04	---	---	23.6

Notes:
All fish tissue results are on a wet-weight basis.

TABLE 11

SUMMARY OF FISH TISSUE DATA - OCTOBER 2009
SITE 3 - CAUSEWAY POND
MCRD PARRIS ISLAND, SOUTH CAROLINA

CAS NO.	PARAMETER	GENERAL'S LANDING CREEK FISH TISSUE DATA							
		FREQUENCY OF DETECTIONS	MINIMUM CONCENTRATION	MAXIMUM CONCENTRATION	LOCATION OF MAXIMUM CONCENTRATION	SAMPLE CONTAINING MAXIMUM CONCENTRATION	MINIMUM NON-DETECT	MAXIMUM NON-DETECT	AVERAGE OF POSITIVE CONCENTRATIONS
	METALS (MG/KG)								
7440-50-8	COPPER	0/9	---	---	---	---	0.54	2.4	---
7439-97-6	MERCURY	1/9	0.0235	0.0235	03BATPOND-RF	PAI-03-BD-RF-01	0.0043	0.0882	0.0235
	PCB CONGENERS (NG/KG)								
32598-14-4	PCB-105	9/9	30.1	319	03BATPOND-RF	PAI-03-RD-RF-08	---	---	110
74472-37-0	PCB-114	2/9	12.5	23	03BATPOND-RF	PAI-03-RD-RF-08	4.08	14.3	17.75
31508-00-6	PCB-118	9/9	94.4	1050	03BATPOND-RF	PAI-03-RD-RF-08	---	---	376
65510-44-3	PCB-123	3/9	11.1	14.5 J	03BATPOND-RF	PAI-03-RD-RF-08	3.51	13.7	12.6
57465-28-8	PCB-126	0/9	---	---	---	---	4.14	19.9	---
--	PCB-156/157	8/9	11.3 J	159	03BATPOND-RF	PAI-03-RD-RF-08	3.13	3.13	49.0
52663-72-6	PCB-167	8/9	5.8 J	54.4	03BATPOND-RF	PAI-03-RD-RF-08	7.59	7.59	24.7
32774-16-6	PCB-169	0/9	---	---	---	---	2.46	7.3	---
39635-31-9	PCB-189	2/9	2.51	5.46 J	03BATPOND-RF	PAI-03-MU-RF-02	1.83	2.96	3.99
32598-13-3	PCB-77	6/9	5.12	28.8	03BATPOND-RF	PAI-03-MU-RF-03	4.74	11.7	13.0
70362-50-4	PCB-81	0/9	---	---	---	---	2.89	11.3	---
--	PCB TEQ	9/9	0.549	2.07	03BATPOND-RF	PAI-03-MU-RF-04	---	---	1.26
--	TOTAL DIOXIN-LIKE PCBs	9/9	135	1630	03BATPOND-RF	PAI-03-RD-RF-08	---	---	569
	PESTICIDES (UG/KG)								
72-54-8	4,4'-DDD	1/9	1.5 J	1.5 J	03BATPOND-RF	PAI-03-MU-RF-04	0.28	0.42	1.5
72-55-9	4,4'-DDE	6/9	0.888 J	5.1 J	03BATPOND-RF	PAI-03-MU-RF-03	0.25	0.35	2.36
50-29-3	4,4'-DDT	1/9	1.3 J	1.3 J	03BATPOND-RF	PAI-03-RD-RF-08	0.28	0.42	1.3
	MISCELLANEOUS PARAMETERS (%)								
--	LIPIDS	9/9	0.53	5.9	03BATPOND-RF	PAI-03-MU-RF-02	---	---	2.48
--	TOTAL SOLIDS	9/9	21	28	03BATPOND-RF	PAI-03-MU-RF-02	---	---	23.9

Notes:
All fish tissue results are on a wet-weight basis.

TABLE 12

ESTIMATION OF FISH TISSUE CONCENTRATIONS FROM 2001/2003 SEDIMENT DATA
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

CAS Number	Chemical	Minimum Sediment Concentration[1]	Maximum Sediment Concentration[1]	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects[2]	Background/Typical Facility Pesticide Concentration[3]	BSAF[4]	Maximum Estimated Fish Tissue Concentration[5]	Recommended Screening Values[6]		Estimated Concentration Exceeds Screening Value
										Recreational Fishers	Subsistence Fishers	
Polynuclear Aromatic Hydrocarbons (µg/kg)												
56-55-3	Benzo(a)anthracene	13 J	18 J	PAI-03-SD-47-01	3/4	28 - 28	NA	NA[7]	NA[7]	NA[7]	NA[7]	NA[7]
205-99-2	Benzo(b)fluoranthene	10 J	15 J	PAI-03-SD-47-01	3/4	28 - 28	NA	NA[7]	NA[7]	NA[7]	NA[7]	NA[7]
218-01-9	Chrysene	6 J	11 J	PAI-03-SD-47-01	3/4	28 - 28	NA	NA[7]	NA[7]	NA[7]	NA[7]	NA[7]
206-44-0	Fluoranthene	25 J	28 J	PAI-03-SD-48-01	3/4	28 - 28	NA	NA[7]	NA[7]	NA[7]	NA[7]	NA[7]
85-01-8	Phenanthrene	10 J	12 J	PAI-03-SD-49-01	2/4	28 - 50	NA	NA[7]	NA[7]	NA[7]	NA[7]	NA[7]
129-00-0	Pyrene	14 J	17 J	PAI-03-SD-47-01, PAI-03-SD-48-01	3/4	28 - 28	NA	NA[7]	NA[7]	NA[7]	NA[7]	NA[7]
	Benzo(a)pyrene Equivalents	32	56	PAI-03-SD-47-01	3/4	28 - 28	NA	NA[7]	NA[7]	NA[7]	NA[7]	NA[7]
Pesticides/PCBs (µg/kg)												
72-54-8	4,4'-DDD	2.1 J	58	PAI-03-SD-59-01	6/11	5.5 - 19	33.6	0.27[8]	39	16.7 C	2.05 C	Yes
72-55-9	4,4'-DDE	1.2 J	26	PAI-03-SD-59-01	10/11	5.7 - 5.7	31.6	[9]	[9]	11.8 C	1.45 C	No
50-29-3	4,4'-DDT	1.3 J	3.8 J	PAI-03-SD-59-01, PAI-03-SD-60-01	3/11	4.3 - 19	34.5	[9]	[9]	11.8 C	1.45 C	No
5103-71-9	alpha-Chlordane	2.8 J	2.8 J	PAI-03-SD-59-01	1/8	2.2 - 9.6	13.9	[9]	[9]	11.4 C[10]	1.4 C[10]	No
5103-74-2	gamma-Chlordane	2 J	3.4	PAI-03-SD-54-01	2/8	2.2 - 9.6	13.2	[9]	[9]	11.4 C[10]	1.4 C[10]	No
Inorganics (mg/kg)												
7440-38-2	Arsenic	0.84	10.5	PAI-03-SD-50-01	18/18	- - -	12	[9]	[9]	0.0026 C	0.000327 C	No
7440-50-8	Copper	1.1	22.5	PAI-03-SD-50-01	15/15	- - -	10	1.556	5.6	16 N	1.97 N	Yes
7439-92-1	Lead	4.2	44.9 J	PAI-03-SD-60-01	18/18	- - -	21	0.071	0.51	NA	NA	No
7439-97-6	Mercury	0.04	0.2	PAI-03-SD-48-01	15/18	0.2 - 0.2	0.09	[8]	0.45[8]	0.04 N	0.0049 N	Yes
7440-66-6	Zinc	6.7	93.3 J	PAI-03-SD-58-01	15/15	- - -	45	1.936	29	120 N	14.7 N	Yes

Footnotes:

1 - Sample and duplicate are considered as two separate samples when determining minimum and maximum concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The background/typical facility pesticide concentrations in sediment represent two times the mean concentrations calculated for each parameter detected in background/typical facility pesticide sediment samples collected at MCRD Parris Island (see Appendix D).
4 - Sediment-to-invertebrate biotransfer factors were used for the inorganics without sediment-to-fish biotransfer factors.
5 - For organics, estimated fish tissue concentration = BSAF x Sediment Concentration x f_l / f_{oc}.
f_l = lipid content (0.025), foc= fraction organic carbon (0.01).
For inorganics, estimated fish tissue concentration = BSAF x Sediment Concentration x 0.16.
6 - Recommended Screening Values (RSVs) from Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories (U.S. EPA, November 2000) are presented. RSVs represent the screening value in the literature divided by 10 to correspond to a target hazard quotient of 0.1 for noncarcinogens (denoted with a "N" flag), or an incremental cancer risk of 1.0E-6 for carcinogens (denoted with a "C" flag).
7 - PAHs were not evaluted in the sediment to fish to human pathway because U.S. EPA Region 4 considers the potential toxicity of PAHs via bioaccumulation fo be generally negligible.
8 - See Appendix G.
9 - Fish tissue concentrations were not calculated for this chemical because the maximum sediment concentration does not exceed the background/typical facility pesticide concentration for sediment.
10 - Chlordane is used as a surrogate for alpha- and gamma-chlordane.

Shaded sample name indicates that the maximum detected concentration exceeds one or more screening criteria.

Definitions:

BSAF = Biota-sediment accumulation factor
C = Carcinogen
COPC = Chemical of potential concern
J = Estimated value
N = Non-carcinogen
NA = Not applicable/not available

<u>**Associated Samples:**</u>

2001 Area 1 Pond Site
PAI-03-SD-46-01
PAI-03-SD-47-01
PAI-03-SD-48-01
PAI-03-SD-49-01
2001 Area 2 Pond Side
PAI-03-SD-50-01
PAI-03-SD-51-01
PAI-03-SD-52-01

2001 Area 3 Pond Side
PAI-03-SD-53-01
PAI-03-SD-54-01
PAI-03-SD-55-01
2001 Area 4 Pond Side
PAI-03-SD-56-01
PAI-03-SD-57-01
PAI-03-SD-58-01
PAI-03-SD-59-01
PAI-03-SD-60-01

2003 Area 4 Pond Side
PAI-03-SD-61-01
PAI-03-SD-62-01
PAI-03-SD-63-01

TABLE 13

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - 3rd BATTALION POND FISH TISSUE
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

CAS Number	Chemical	Minimum Fish Concentration(1)	Maximum Fish Concentration(1)	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects(2)	Average Fish Tissue Concentration General's Crossing Creek(3)	Recommended Screening Values(4)		COPC Flag	Rationale for Contaminant Deletion or Selection(5)
								Recreational Fishers	Subsistence Fishers		
Pesticides/PCBs (µg/kg)											
72-54-8	4,4'-DDD	2.4 J	14 J	PAI-03-MU-04-03	10/18	0.34 - 0.42	3.0	16.7 C	2.05 C	Y	ASL
72-55-9	4,4'-DDE	1.5 J	71 J	PAI-03-MU-04-04	18/18	---	4.8	11.8 C	1.45 C	Y	ASL
50-29-3	4,4'-DDT	1.6 J	7.2 J	PAI-03-MU-04-04	13/18	0.34 - 4.2	2.6	11.8 C	1.45 C	Y	ASL
	Total PCBs (dioxin like)	5.40E-06	6.97E-03	PAI-03-MU-04-04	18/18	---	3.6E-05	3.08E-05 C	3.78E-06 C	Y	ASL
Inorganics (mg/kg)											
7440-50-8	Copper	---	---	---	0/18	0.22 - 0.71	---	16 N	1.97 N	---	---
7439-97-6	Mercury	0.0155	0.564	PAI-03-RD-04-01	7/18	0.0019 - 0.106	0.047	0.04 N	0.0049 N	Y	ASL

Footnotes:
All fish tissue results are on a wet-weight basis.
1 - Sample and duplicate are considered as two separate samples when determining minimum and maximum concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The values presented here are two times the average of the positive concentrations from the samples collected in General's Crossing Creek (reference location).
4 - Recommended Screening Values (RSVs) from Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories (U.S. EPA, November 2000) are presented. RSVs represent the screening value in the literature divided by 10 to correspond to a target hazard quotient of 0.1 for noncarcinogens (denoted with a "N" flag), or an incremental cancer risk of 1.0E-6 for carcinogens (denoted with a "C" flag).
5 - The chemical is selected as a COPC if the fish tissue concentration exceeds the average fish tissue concentration from General's Crossing Creek and the RSVs.

Shaded chemical name indicates that the chemical was retained as a COPC.

Definitions:
C = Carcinogen
COPC = Chemical of potential concern
J = Estimated value
N = Non-carcinogen
NA = Not applicable/not available

Rationale Codes:
For selection as a COPC:

ASL = Above screening level.

For elimination as a COPC:
BSL = Below COPC screening level

TABLE 14A

EXPOSURE POINT CONCENTRATIONS - FISH TISSUE 3RD BATTALION POND SAMPLES
SITE/SWMU 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

Chemical	Fish Tissue Concentration(1) (mg/kg)	Statistic
4,4'-DDD	0.0059	95% KM(T)
4,4'-DDE	0.029	95% APPROXIMATE GAMMA
4,4'-DDT	0.0037	95% KM(PERCENTILE BOOTSTRAP)
TEQ PCBs	0.0000026	95% KM(PERCENTILE BOOTSTRAP)
Mercury	0.143	95% KM(T)

Notes:
1 - UCL as identified by PRO UCL 4.0.04 for the fish samples collected from the 3rd Battalion Pond.

TABLE 14B

EXPOSURE POINT CONCENTRATIONS - FISH TISSUE
GENERAL'S LANDING CREEK - REFERENCE LOCATION
SITE/SWMU 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

Chemical	Fish Tissue Concentration(1) (mg/kg)	Statistic
4,4'-DDD	0.0015	95% KM(T)
4,4'-DDE	0.0028	95% APPROXIMATE GAMMA
4,4'-DDT	0.0013	95% KM(PERCENTILE BOOTSTRAP)
TEQ PCBs	0.00000162	95% STUDENT'S UCL
Mercury	0.0235	MAXIMUM CONCENTRATION

Notes:
1 - UCL as identified by PRO UCL 4.0.04 for the fish samples collected from the reference location.

TABLE 15

SUMMARY OF EXPOSURE INPUT PARAMETERS
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

Exposure Parameter	Child		Adult			
	Recreational Fisher Military/Civilian	Subsistence Fisher Civilian	Recreational Fisher Military	Recreational Fisher Civilian	Subsistence Fisher Civilian	EPA Region IV Default
All Exposures						
Ingestion Rate (g/day)	17.5[(1)]	142.4[(1)]	17.5[(1)]	17.5[(1)]	142.4[(1)]	54
Fraction Ingested (unitless)	1	1	1	1	1	1
Exposure Frequency (meals/year)	365	365	365	365	365	350
Exposure Duration (years)	3[(2)]	3[(3)]	6[(4)]	70[(5)]	70[(5)]	30
Body Weight (kg)	17[(2)]	30[(6)]	70	70	70	70
Averaging Time - noncarcinogens (days)	1,095	1,095	2,190	25,550	25,550	10,950
Averaging Time - carcinogens (days)	25,550	25,550	25,550	25,550	25,550	25,550

Notes:

All exposure assumptions are U.S. EPA Region 4 default values unless otherwise noted.

1 - Consumption rates from U.S. EPA guidance. These are based on averaging yearly consumption volumes over 1 year (U.S. EPA, November 2000).

2 - Assumes a child ages 3 to <6 years (U.S. EPA, November 2000).

3 - Assumes a child age 8 to 10 (based on interview with civilian subsistence fisher (Appendix B).

4 - Assumes military personnel stationed at the base who spends two 3-year tours of duty at the site.

5 - Exposure durations as Identified in U.S. EPA guidance (U.S. EPA, November 2000).

6 - Approximate average weight of child 6 to >9 (25 kg) and child 9 to <12 (36 kg) (U.S. EPA, November 2000).

TABLE 16

NON-CANCER TOXICITY DATA -- ORAL/DERMAL
SITE 3 CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal[1]	Absorbed RfD for Dermal[2]		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD:Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Pesticides										
4,4'-DDD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dioxin-Like PCBs										
2,3,7,8-TCDD (dioxin-like PCBs)	Chronic	1.0E-09	mg/kg/day	1	1.0E-09	mg/kg/day	NA	NA	ATSDR	12/2009
Inorganics										
Copper	Chronic	4.0E-02	mg/kg/day	1	4.0E-02	mg/kg/day	GS	NA	HEAST	7/1997
Mercury[3]	Chronic	1.0E-04	mg/kg/day	1	1.0E-04	mg/kg/day	CNS	10/1	IRIS	5/13/2010

1 - U.S. EPA, July 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.
2 - Adjusted dermal RfD = Oral RfD x Oral Absorption Efficiency for Dermal.
3 - Values are for methyl mercury.
ATSDR = Agency for Toxic Substances and Disease Registry
CNS = Central Nervous System
GS = Gastrointestinal
HEAST = Health Effects Assessment Summary Tables
IRIS = Integrated Risk Information System
NA = Not applicable

TABLE 17

CANCER TOXICITY DATA -- ORAL/DERMAL
SITE 3 CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal(1)	Absorbed Cancer Slope Factor for Dermal(2)		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units		Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Pesticides								
4,4'-DDD	2.4E-01	$(mg/kg/day)^{-1}$	1	2.4E-01	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	IRIS	5/13/2010
4,4'-DDE	3.4E-01	$(mg/kg/day)^{-1}$	1	3.4E-01	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	IRIS	5/13/2010
4,4'-DDT	3.4E-01	$(mg/kg/day)^{-1}$	1	3.4E-01	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	IRIS	5/13/2010
Dioxin-Like PCBs								
2,3,7,8-TCDD (dioxin-like PCBs)	1.3E+05	$(mg/kg/day)^{-1}$	1	1.3E+05	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	ATSDR	12/2009
Inorganics								
Copper	NA	NA	NA	NA	NA	D / Not classifiable as to human carcinogenicity	IRIS	5/13/2010
Mercury	NA	NA	NA	NA	NA	C / Inadequate data of carcinogenicity in humans	IRIS	5/13/2010

1 - U.S. EPA, July 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.
2 - Adjusted cancer slope factor for dermal = Oral cancer slope factor / Oral Absorption Efficiency for Dermal.
ATSDR = Agency for Toxic Substances and Disease Registry
IRIS = Integrated Risk Information System.
NA = Not available.

TABLE 18A

SUMMARY OF CANCER RISKS AND HAZARD INDICES
3RD BATTALION POND SAMPLES
SITE/SWMU 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

Receptor	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals Contributing to an Target Organ HI > 1[1]
Child Recreational Fisher	2E-05	- -	- -	Dioxin-Like PCBs	4	Dioxin-Like PCBs (3)
Child Subsistence Fisher	7E-05	- -	Dioxin-Like PCBs	4,4'-DDE	19	Dioxin-Like PCBs (12), Mercury (7)
Adult Recreational Military Fisher	8E-06	- -	- -	Dioxin-Like PCBs	1	- -
Adult Recreational Civilian Fisher	9E-05	- -	Dioxin-Like PCBs	4,4'-DDE	1	- -
Adult Subsistence Fisher	7E-04	Dioxin-Like PCBs	4,4'-DDE	4,4'-DDD, 4,4'-DDT	8	Dioxin-Like PCBs (5), Mercury (3)
Default Adult Recreational Fisher	1E-04	- -	Dioxin-Like PCBs	4,4'-DDE	3	Dioxin-Like PCBs (2)
Original Adult Recreational Fisher[2]	4E-05	- -	Dioxin-Like PCBs	- -	1	- -

1 - Chemical-specific HIs exceeding 1 are presented in parentheses.
2 - As a point of comparison, risk estimates are provided based on exposure assumptions evaluated in the original RIF document.

TABLE 18B

SUMMARY OF CANCER RISKS AND HAZARD INDICES - REFERENCE SAMPLES
GENERAL'S LANDING CREEK - REFERENCE LOCATION
SITE/SWMU 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

Receptor	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals Contributing to an Target Organ HI > 1[1]
Child Recreational Fisher	9E-06	- -	- -	Dioxin-Like PCBs	2	Dioxin-Like PCBs (2)
Child Subsistence Fisher	4E-05	- -	Dioxin-Like PCBs	- -	9	Dioxin-Like PCBs (8)
Adult Recreational Military Fisher	5E-06	- -	- -	Dioxin-Like PCBs	0.5	- -
Adult Recreational Civilian Fisher	5E-05	- -	Dioxin-Like PCBs	- -	0.5	- -
Adult Subsistence Fisher	4E-04	Dioxin-Like PCBs	- -	4,4'-DDE	4	Dioxin-Like PCBs (3)
Default Adult Recreational Fisher	7E-05	- -	Dioxin-Like PCBs	- -	1	- -
Original Adult Recreational Fisher[2]	2E-05	- -	Dioxin-Like PCBs	- -	0.5	- -

1 - Chemical-specific HIs exceeding 1 are presented in parentheses.
2 - As a point of comparison, risk estimates are provided based on exposure assumptions evaluated in the original RIF document.

TABLE 19

NORMALIZED FISH TISSUE STATISTICAL COMPARISONS
GENERAL'S LANDING CREEK - REFERENCE LOCATION
SITE/SWMU 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

	Method 1 Comparison Pond Maximum to Twice Reference Average			Method 2 Comparison Hypothesis Test	
TEQ PCB - Full DL	Maximum Pond Concentration (ng/kg)	Average Reference Concentration (ng/kg)	Conclusion	P-Value	Conclusion
Lipid Normalized Comparison	3.4	0.67	Pond does not represent Background	0.041	Pond does not represent Background
Length Normalized Comparison	0.13	0.034	Pond does not represent Background	0.34	Pond represents Background
Lipid and Length Normalized Comparison	0.068703	0.017977	Pond does not represent Background	0.083	Pond represents Background

P-value < 0.05 indicates that the data are statistically different

TABLE 20

SELECTION OF ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN MARSH-SIDE SEDIMENT SAMPLES
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

Analyte	Frequency of Detection	Range of Detected Values	Location of Maximum Concentration	Range of Detection Limits in Non-Detect Samples	Ecological Screening Value	Maximum Hazard Quotient[(1)]	COPC (Yes/No)[(2)]
PAHs (µg/kg)							
Acenaphthene	1/5	28	PAI-03-SD-41-01-D	26 - 70	6.71	4.2	Yes
Anthracene	2/5	14 - 78	PAI-03-SD-41-01-D	26 - 70	46.9	1.7	Yes
Benzo(a)anthracene	5/5	12 - 300	PAI-03-SD-41-01-D	-	74.8	4.0	Yes
Benzo(a)pyrene	3/5	11 - 170	PAI-03-SD-41-01-D	56 - 70	88.8	1.9	Yes
Benzo(b)fluoranthene	5/5	13 - 230	PAI-03-SD-41-01-D	-	NA	NA	Yes
Benzo(g,h,i)perylene	3/5	12 - 71	PAI-03-SD-41-01-D	56 - 70	NA	NA	Yes
Benzo(k)fluoranthene	3/5	7 - 82	PAI-03-SD-41-01-D	56 - 70	NA	NA	Yes
Chrysene	3/5	12 - 190	PAI-03-SD-41-01-D	56 - 70	108	1.8	Yes
Dibenzo(a,h)anthracene	2/5	12 - 26	PAI-03-SD-41-01-D	28 - 70	6.22	4.2	Yes
Fluoranthene	5/5	34 - 470	PAI-03-SD-41-01-D	-	113	4.2	Yes
Fluorene	2/5	8 - 37	PAI-03-SD-41-01-D	26 - 70	21.2	1.7	Yes
Indeno(1,2,3-cd)pyrene	3/5	18 - 120	PAI-03-SD-41-01-D	28 - 70	NA	NA	Yes
Phenanthrene	3/5	7 - 320	PAI-03-SD-41-01-D	56 - 70	86.7	3.7	Yes
Pyrene	5/5	12 - 330	PAI-03-SD-41-01-D	-	153	2.2	Yes
Total PAHs[(3)]	5/5	216 - 1991	PAI-03-SD-41-01-D	-	1684	1.2	Yes
Pesticides (µg/kg)							
4,4'-DDD	2/5	1.4 - 3.8	PAI-03-SD-41-01	7.0-12	1.22	3.1	Yes
4,4'-DDE	5/5	1.4 - 2.9	PAI-03-SD-43-01	-	2.07	1.4	Yes
4,4'-DDT	2/5	1.5 - 12.0	PAI-03-SD-41-01	7.0-12	1.19	10.1	Yes
Total DDT[(4)]	5/5	4.4 - 17.6	PAI-03-SD-41-01	-	1.58	11.1	Yes
Alpha-Chlordane	1/5	6.6	PAI-03-SD-42-01	2.4-6.0	0.5	13.2	Yes
Inorganics (mg/kg)							
Arsenic	5/5	1.8 - 13.6	PAI-03-SD-44-01	-	7.24	1.9	Yes
Copper	5/5	3.5 - 27.1	PAI-03-SD-44-01	-	18.7	1.4	Yes
Lead	5/5	5.3 - 27.3	PAI-03-SD-44-01	-	30.2	0.9	No
Mercury	5/5	0.01 - 0.06	PAI-03-SD-43/44-01	-	0.13	0.5	No
Zinc	5/5	9.7 - 67.7	PAI-03-SD-44-01	-	124	0.5	No

Notes:
Marsh samples consisted of SD-41, SD-42, SD-43, SD-44, and SD-45. PCBs were not detected in these samples.
NA = USEPA Region 4 ecological screening value not available.

1 Hazard quotient (HQ) = maximum detected concentration ÷ ecological screening value.

2 An analyte was an ecological chemical of potential concern (COPC) if the maximum detected concentration was greater than the ecological screening value (i.e., HQ>1), or if an ecological screening value was not available.

3 Total PAH concentrations were calculated as the sum of concentrations of 2-methylnaphthalene, acenaphthene, acenapththylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene. One-half the detection limit was used to represent non-detected PAHs.

4 Total DDT = the sum of concentrations of 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT isomers using one-half the detection limit to represent non-detected isomers.

TABLE 21

SELECTION OF ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN POND-SIDE SEDIMENT AREA 1
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

Analyte	Frequency of Detection	Range of Detected Values	Location of Maximum Concentration	Range of Detection Limits in Non-Detect Samples	Ecological Screening Value	Maximum Hazard Quotient[1]	COPC (Yes/No)[2]
PAHs (µg/kg)							
Benzo(a)anthracene	3/4	13 - 18	PAI-03-SD-47-01	28	74.8	0.2	No
Benzo(b)fluoranthene	3/4	10 - 15	PAI-03-SD-47-01	28	NA	NA	Yes
Chrysene	3/4	6 - 11	PAI-03-SD-47-01	28	108	0.1	No
Fluoranthene	3/4	25 - 28	PAI-03-SD-48-01	28	113	0.2	No
Phenanthrene	2/4	10 - 12	PAI-03-SD-49-01	28 - 50	86.7	0.1	No
Pyrene	3/4	14 - 17	PAI-03-SD-48-01	28	153	0.1	No
Total PAHs[3]	3/4	213 - 340	PAI-03-SD-47-01	-	1684	0.2	No
Inorganics (mg/kg)							
Arsenic	4/4	0.84 - 7.7	PAI-03-SD-47-01	-	7.24	1.1	Yes
Copper	4/4	1.1 - 10.2	PAI-03-SD-47-01	-	18.7	0.5	No
Lead	4/4	4.2 - 17.7	PAI-03-SD-47-01	-	30.2	0.6	No
Mercury	4/4	0.04 - 0.2	PAI-03-SD-48-01	-	0.13	1.5	Yes
Zinc	4/4	6.7 - 36.1	PAI-03-SD-47-01	-	124	0.3	No

Notes:
Area # 1 consisted of samples SD-46, SD-47, SD-48, and SD-49. These samples were not analyzed for pesticides or PCBs.
NA = USEPA Region 4 ecological screening value not available.

1 Hazard quotient (HQ) = maximum detected concentration ÷ ecological screening value.

2 An analyte was an ecological chemical of potential concern (COPC) if the maximum detected concentration was greater than the ecological screening value (i.e., HQ>1), or if an ecological screening value was not available.

3 Total PAH concentrations were calculated as the sum of concentrations of 2-methylnaphthalene, acenaphthene, acenapththylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene. One-half the detection limit was used to represent non-detected PAHs.

TABLE 22

SELECTION OF ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN POND-SIDE SEDIMENT AREA 2
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

Analyte	Frequency of Detection	Range of Detected Values	Location of Maximum Concentration	Ecological Screening Value	Maximum Hazard Quotient(1)	COPC (Yes/No)(2)
Inorganics (mg/kg)						
Arsenic	3/3	5.2 - 10.5	PAI-03-SD-50-01	7.24	1.5	Yes
Copper	3/3	7.7 - 22.5	PAI-03-SD-50-01	18.7	1.2	Yes
Lead	3/3	13.3 - 35.8	PAI-03-SD-50-01	30.2	1.2	Yes
Mercury	3/3	0.07 - 0.13	PAI-03-SD-52-01	0.13	1.0	No
Zinc	3/3	25.4 - 72.5	PAI-03-SD-50-01	124	0.6	No

Notes:
Area # 2 consisted of samples SD-50, SD-51, and SD-52. These samples were not analyzed for PAHs or pesticides, and PCBs were not detected.

1 Hazard quotient (HQ) = maximum detected concentration ÷ ecological screening value.
2 An analyte was an ecological chemical of potential concern (COPC) if the maximum detected concentration was greater than the ecological screening value (i.e., HQ>1), or if an ecological screening value was not available.

TABLE 23

SELECTION OF ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN POND-SIDE SEDIMENT AREA 3
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

Analyte	Frequency of Detection	Range of Detected Values	Location of Maximum Concentration	Range of Detection Limits in Non-Detect Samples	Ecological Screening Value	Maximum Hazard Quotient[1]	COPC (Yes/No)[2]
Pesticides (µg/kg)							
4,4'-DDD	1/3	2.7	PAI-03-SD-55-01	5.5 - 5.7	1.22	2.2	Yes
4,4'-DDE	2/3	1.2 -1.7	PAI-03-SD-55-01	5.7	2.07	0.8	No
4,4'-DDT	1/3	1.3	PAI-03-SD-55-01	5.5 - 5.7	1.19	1.1	Yes
Total DDT[3]	2/3	5.7 - 6.7	PAI-03-SD-54-01	-	1.58	4.2	Yes
Gamma-Chlordane	1/3	3.4	PAI-03-SD-54-01	2.9 - 3.2	0.5	6.8	Yes
Inorganics (mg/kg)							
Arsenic	3/3	2.1 -5.1	PAI-03-SD-55-01	-	7.24	0.7	No
Copper	3/3	3.2 -5.6	PAI-03-SD-55-01	-	18.7	0.3	No
Lead	3/3	9.9 -13.7	PAI-03-SD-55-01	-	30.2	0.5	No
Mercury	3/3	0.04 -0.09	PAI-03-SD-53-01	-	0.13	0.7	No
Zinc	3/3	16.5 -25.9	PAI-03-SD-55-01	-	124	0.2	No

Notes:
Area # 3 consisted of samples SD-53, SD-54, and SD-55. These samples were not analyzed for PAHs or PCBs.

1 Hazard quotient (HQ) = maximum detected concentration ÷ ecological screening value.
2 An analyte was an ecological chemical of potential concern (COPC) if the maximum detected concentration was greater than the ecological screening value (i.e., HQ>1), or if an ecological screening value was not available.
3 Total DDT = the sum of concentrations of 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT isomers using one-half the detection limit to represent non-detected isomers.

TABLE 24

SELECTION OF ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN POND-SIDE SEDIMENT AREA 4
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

2001 Sediment Samples

Analyte	Frequency of Detection	Range of Detected Values	Location of Maximum Concentration	Range of Detection Limits in Non-Detect Samples	Ecological Screening Value	Maximum Hazard Quotient(1)	COPC (Yes/No)(2)
Pesticides (µg/kg)							
4,4'-DDD	3/5	2.1 - 58	PAI-03-SD-59-01	7.8 - 19	1.22	47.5	Yes
4,4'-DDE	5/5	2.8 - 26	PAI-03-SD-59-01	0	2.07	12.6	Yes
4,4'-DDT	2/5	3.8	PAI-03-SD-59/60-01	4.3 - 19	1.19	3.2	Yes
Total DDT(3)	5/5	7.05 - 87.8	PAI-03-SD-59-01	-	1.58	55.6	Yes
Alpha-Chlordane	1/5	2.8	PAI-03-SD-59-01	2.2 - 9.6	0.5	5.6	Yes
Gamma-Chlordane	1/5	2	PAI-03-SD-57-01	2.2 - 9.6	0.5	4.0	Yes
Inorganics (mg/kg)							
Arsenic	5/5	1.6 -4.5	PAI-03-SD-58-01	-	7.24	0.6	No
Copper	5/5	4.2 -13.2	PAI-03-SD-60-01	-	18.7	0.7	No
Lead	5/5	14.6 -44.9	PAI-03-SD-60-01	-	30.2	1.5	Yes
Mercury	5/5	0.04 -0.16	PAI-03-SD-57/58-01	-	0.13	1.2	Yes
Zinc	5/5	38.1 -93.3	PAI-03-SD-60-01	-	124	0.8	No

Notes:
Samples collected in Area # 4 in 2001 consisted of SD-56, SD-57, SD-58, SD-59, and SD-60; these were not analyzed for PAHs or PCBs.

2003 Sediment Samples

Analyte	Frequency of Detection	Range of Detected Values	Location of Maximum Concentration	Range of Detection Limits in Non-Detect	Ecological Screening Value	Maximum Hazard Quotient(1)	COPC (Yes/No)(2)
Pesticides (µg/kg)							
4,4'-DDD	2/3	4.9 - 5.7	PAI-03-SD-61-01	12	1.22	4.7	Yes
4,4'-DDE	3/3	2.5 - 5.2	PAI-03-SD-61-01	-	2.07	2.5	Yes
Total DDT(3)	3/3	14.5 - 17.4	PAI-03-SD-61-01	-	1.58	11.0	Yes
Inorganics (mg/kg)							
Arsenic	3/3	5.3 - 6.4	PAI-03-SD-63-01	-	7.24	0.9	No
Lead	3/3	13 - 22	PAI-03-SD-63-01	-	30.2	0.7	No

Notes:
Samples collected in Area # 4 in 2003 consisted of SD-61, SD-62, and SD-63; these were not analyzed for PAHs or PCBs.

1 Hazard quotient (HQ) = maximum detected concentration ÷ ecological screening value.
2 An analyte was an ecological chemical of potential concern (COPC) if the maximum detected concentration was greater than the ecological screening value (i.e., HQ>1), or if an ecological screening value was not available.
3 Total DDT = the sum of concentrations of 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT isomers using one-half the detection limit to represent non-detected isomers.

TABLE 25

SELECTION OF ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SITE-WIDE SEDIMENT(1)
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

Analyte	Frequency of Detection	Range of Detected Values	Location of Maximum Concentration	Range of Detection Limits in Non-Detect Samples	Ecological Screening Value	Maximum Hazard Quotient(2)	COPC (Yes/No)(3)
Semivolatile Organic Compounds (µg/kg)							
Acenaphthene	1/9	28	PAI-03-SD-41-01-D	26 - 70	6.71	4.2	Yes
Anthracene	2/9	14 - 78	PAI-03-SD-41-01-D	26 - 70	46.9	1.7	Yes
Benzo(a)anthracene	8/9	12 - 300	PAI-03-SD-41-01-D	28	74.8	4.0	Yes
Benzo(a)pyrene	3/9	11 - 170	PAI-03-SD-41-01-D	28 - 70	88.8	1.9	Yes
Benzo(b)fluoranthene	8/9	10 - 230	PAI-03-SD-41-01-D	28	NA	NA	Yes
Benzo(g,h,i)perylene	3/9	12 - 71	PAI-03-SD-41-01-D	28 - 70	NA	NA	Yes
Benzo(k)fluoranthene	3/9	7 - 82	PAI-03-SD-41-01-D	28 - 70	NA	NA	Yes
Chrysene	6/9	6 - 190	PAI-03-SD-41-01-D	28 - 70	108	1.8	Yes
Dibenzo(a,h)anthracene	2/9	12 - 26	PAI-03-SD-41-01-D	28 - 70	6.22	4.2	Yes
Fluoranthene	8/9	21 - 470	PAI-03-SD-41-01-D	28	113	4.2	Yes
Fluorene	2/9	8 - 37	PAI-03-SD-41-01-D	26 - 70	21.2	1.7	Yes
Indeno(1,2,3-cd)pyrene	3/9	18 - 120	PAI-03-SD-41-01-D	28 - 70	NA	NA	Yes
Phenanthrene	5/9	7 - 320	PAI-03-SD-41-01-D	28 - 70	86.7	3.7	Yes
Pyrene	8/9	12 - 330	PAI-03-SD-41-01-D	28	153	2.2	Yes
Total PAHs(4)	8/9	213-1991	PAI-03-SD-41-01-D	-	1684	1.2	Yes
Pesticides/PCBs (µg/kg)							
4,4'-DDD	8/16	1.4 - 58	PAI-03-SD-59-01	5.5 - 19	1.22	47.5	Yes
4,4'-DDE	15/16	1.2 - 26	PAI-03-SD-59-01	5.7	2.07	12.6	Yes
4,4'-DDT	5/16	1.1 - 12	PAI-03-SD-41-01	4.3 - 19	1.19	10.1	Yes
Total DDT(5)	15/16	4.4 - 87.8	PAI-03-SD-59-01	-	1.58	55.6	Yes
Alpha-Chlordane	2/13	2.8 - 6.6	PAI-03-SD-42-01	2.2 - 9.6	0.5	13.2	Yes
Gamma-Chlordane	2/13	2 - 3.4	PAI-03-SD-54-01	2.2 - 9.6	0.5	6.8	Yes
Inorganics (mg/kg)							
Arsenic	23/23	0.84 - 13.6	PAI-03-SD-44-01	-	7.24	1.9	Yes
Copper	20/20	1.1 - 27.1	PAI-03-SD-44-01	-	18.7	1.4	Yes
Lead	23/23	4.2 - 44.9	PAI-03-SD-60-01	-	30.2	1.5	Yes
Mercury	20/23	0.01 - 0.2	PAI-03-SD-48-01	0.19 - 0.2	0.13	1.5	Yes
Zinc	20/20	6.7 - 93.3	PAI-03-SD-58-01	-	124	0.8	No

Notes:
NA = USEPA Region 4 ecological screening value not available.

1 Site-wide data set consists of all samples collected in 2001 and 2003.
2 Hazard quotient (HQ) = maximum detected concentration ÷ ecological screening value.
3 An analyte was an ecological chemical of potential concern (COPC) if the maximum detected concentration was greater than the ecological screening value (i.e., HQ>1), or if an ecological screening value was not available.
4 Total PAH concentrations = the sum of concentrations of 2-methylnaphthalene, acenaphthene, acenapththylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene. One-half the detection limit was used to represent non-detected PAHs.
5 Total DDT = the sum of concentrations of 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT isomers using one-half the detection limit to represent non-detected isomers.

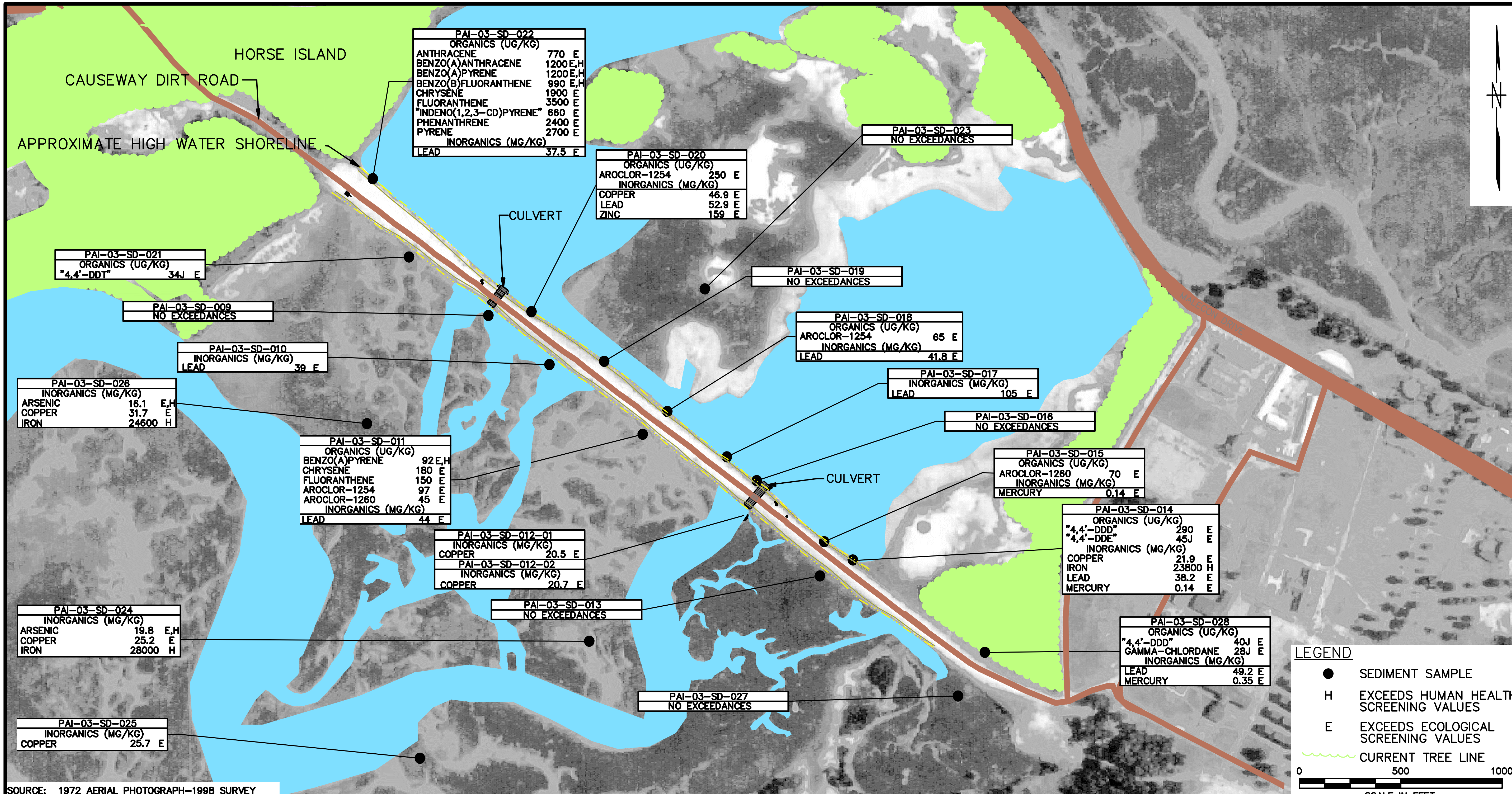
TABLE 26

DATA SUMMARY FOR ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SITE-WIDE SEDIMENT[1]
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

Analyte	Frequency of Detection	Range of Detected Values	Location of Maximum Concentration	Range of Detection Limits in Non-Detect Samples	Ecological Screening Value (ESV)	Maximum Hazard Quotient[2]	Average Detected Conc.[3]	Average of all Conc.[4]	Number of Detects Exceeding ESV	Background/ Typical Facility Conc[5]	Retained as Final COPC in Sediment?
Semivolatile Organic Compounds (µg/kg)											
Acenaphthene	1/9	28	PAI-03-SD-41-01-D	26 - 70	6.71	4.2	28	22	1	NA	No[6]
Anthracene	2/9	14 - 78	PAI-03-SD-41-01-D	26 - 70	46.9	1.7	30	23	1	NA	No[6]
Benzo(a)anthracene	8/9	12 - 300	PAI-03-SD-41-01-D	28	74.8	4.0	45	42	1	NA	No[6]
Benzo(a)pyrene	3/9	11 - 170	PAI-03-SD-41-01-D	28 - 70	88.8	1.9	54	33	1	NA	No[6]
Benzo(b)fluoranthene	8/9	10 - 230	PAI-03-SD-41-01-D	28	NA	NA	36	34	NA	NA	No[6]
Benzo(g,h,i)perylene	3/9	12 - 71	PAI-03-SD-41-01-D	28 - 70	NA	NA	28	24	NA	NA	No[6]
Benzo(k)fluoranthene	3/9	7 - 82	PAI-03-SD-41-01-D	28 - 70	NA	NA	28	24	NA	NA	No[6]
Chrysene	6/9	6 - 190	PAI-03-SD-41-01-D	28 - 70	108	1.8	31	29	1	NA	No[6]
Dibenzo(a,h)anthracene	2/9	12 - 26	PAI-03-SD-41-01-D	28 - 70	6.22	4.2	19	21	2	NA	No[6]
Fluoranthene	8/9	21 - 470	PAI-03-SD-41-01-D	28	113	4.2	71	65	2	NA	No[6]
Fluorene	2/9	8 - 37	PAI-03-SD-41-01-D	26 - 70	21.2	1.7	17	20	1	NA	No[6]
Indeno(1,2,3-cd)pyrene	3/9	18 - 120	PAI-03-SD-41-01-D	28 - 70	NA	NA	44	29	NA	NA	No[6]
Phenanthrene	5/9	7 - 320	PAI-03-SD-41-01-D	28 - 70	86.7	3.7	53	41	1	NA	No[6]
Pyrene	8/9	12 - 330	PAI-03-SD-41-01-D	28	153	2.2	44	41	1	NA	No[6]
Total PAHs[7]	8/9	213-1991	PAI-03-SD-41-01-D	-	1684	1.2	440	-	1	NA	No[6]
Pesticides/PCBs (µg/kg)											
4,4'-DDD	8/16	1.4 - 58	PAI-03-SD-59-01	5.5 - 19	1.22	47.5	11.3	8.1	8	33.6	No[6]
4,4'-DDE	15/16	1.2 - 26	PAI-03-SD-59-01	5.7	2.07	12.6	4.8	4.7	9	31.6	No[6]
4,4'-DDT	5/16	1.1 - 12	PAI-03-SD-41-01	4.3 - 19	1.19	10.1	3.4	4.5	5	34.5	No[6]
Total DDT[8]	15/16	4.4 - 87.8	PAI-03-SD-59-01	-	1.58	55.6	17.3	-	15	99.8	No[6]
Alpha-Chlordane	2/13	2.8 - 6.6	PAI-03-SD-42-01	2.2 - 9.6	0.5	13.2	4.7	2.5	2	13.9	No[6]
Gamma-Chlordane	2/13	2 - 3.4	PAI-03-SD-54-01	2.2 - 9.6	0.5	6.8	2.7	2.2	2	13.2	No[6]
Inorganics (mg/kg)											
Arsenic	23/23	0.84 - 13.6	PAI-03-SD-44-01	-	7.24	1.9	4.8	4.8	5	12.2	No[6]
Copper	20/20	1.1 - 27.1	PAI-03-SD-44-01	-	18.7	1.4	9.1	9.1	3	10.1	No[6]
Lead	23/23	4.2 - 44.9	PAI-03-SD-60-01	-	30.2	1.5	18.1	18.1	3	20.6	No[6]
Mercury	20/23	0.01 - 0.2	PAI-03-SD-48-01	0.19 - 0.2	0.13	1.5	0.087	0.088	5	0.09	No[6]

Notes:
NA = USEPA Region 4 ecological screening value not available, or background value not available.

1 Site-wide data set consists of all samples collected in 2001 and 2003.
2 Hazard quotient = maximum detected concentration ÷ ecological screening value.
3 Average of detected concentrations, except for total PAHs (see note 7) and total DDT (see note 8).
4 Average concentration of all samples using one-half the detection limit to represent non-detected samples.
5 Background and typical facility pesticide concentrations represent twice the mean concentrations for each analyte detected in background/typical facility pesticide samples (see Appendix D).
6 The decision to retain preliminary COPCs for evaluation beyond Step 3A is a risk management decision; a "yes" or "no" indication here is intended only as a recommendation to risk managers. Furthermore, reasons for retaining or eliminating as final COPCs for Site 3 were based on multiple factors using a weight-of-evidence approach (see Section 6.3.2). Finally, the yes/no recommendations shown in this site-wide data set table are also pertinent to Areas 1-4 and marsh samples when evaluated as separate areas.
7 In samples with at least one detected PAH, total PAHs = the sum of concentrations of 2-methylnaphthalene, acenaphthene, acenapththylene, anthracene, benzo(a)anthracene, dibenzo(a,h)anthracene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene using one-half the detection limit to represent non-detected PAHs.
8 Total DDT = the sum of concentrations of 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT isomers using one-half the detection limit to represent non-detected isomers; calculated in samples with at least one detected isomer.



DRAWN BY CK	DATE 9-29-09
CHECKED BY	DATE
REVISED BY	DATE
SCALE 1"=500'	

NAVFAC

1998 SEDIMENT SAMPLE RESULTS THAT EXCEED BACKGROUND, HUMAN HEALTH RBC's AND/OR ECOLOGICAL SCREENING VALUES
SITE 3-CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NO. 7394
OWNER NO.
APPROVED BY DATE
DRAWING NO. FIGURE 1 REV. 0

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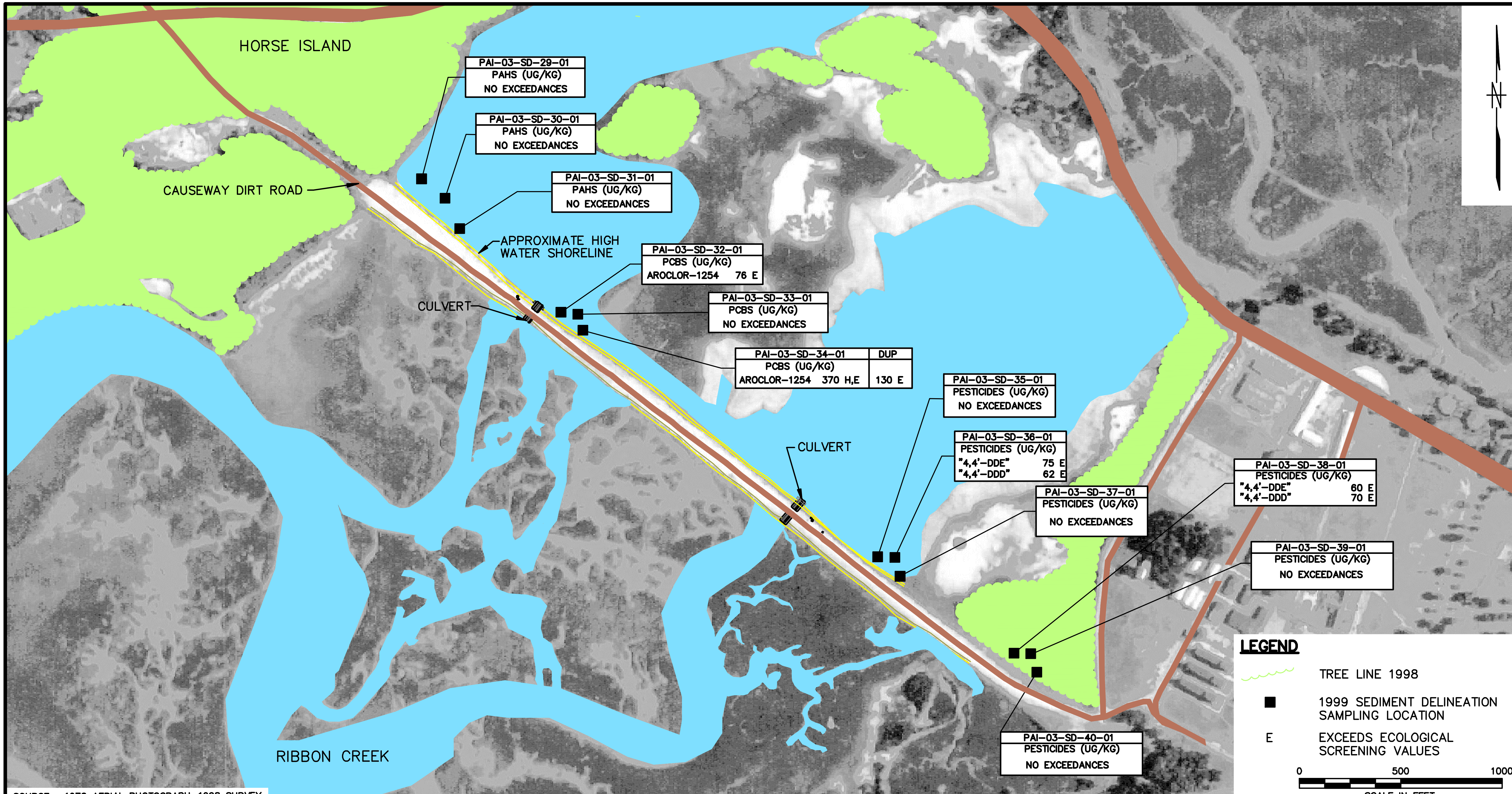

DRAWN BY CK	DATE 9-29-09
CHECKED BY	DATE
REVISED BY	DATE
SCALE 1"=500'	

NAVFAC

1999 SEDIMENT DELINEATION SAMPLING ANALYTICAL RESULTS SITE 3-CAUSEWAY LANDFILL MCRD PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NO. 7394	
OWNER NO.	
APPROVED BY	DATE
DRAWING NO. FIGURE 2	REV. 0

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DRAWN BY	DATE
CK	9-29-09
CHECKED BY	DATE
REVISED BY	DATE
SCALE	1"=240'

NAVFAC

POST CONSTRUCTION SEDIMENT SAMPLE LOCATIONS
SITE 3 – CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NO.	
3920	
OWNER NO.	
APPROVED BY APVD_BY	DATE APVD_DATE
DRAWING NO. FIGURE 3	REV. 0

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P:\GIS\PARRIS_ISLAND_MCRD\MXD\SITE03_QUADRANTS.MXD 12/15/09 SS

DRAWN BY K. MOORE	DATE 08/07/09	NAVFAC	FISH TISSUE SAMPLE LOCATIONS 3RD BATTALION POND SITE 3 - CAUSEWAY LANDFILL MCRD PARRIS ISLAND, SOUTH CAROLINA	CONTRACT NUMBER 00106
CHECKED BY G. ZIMMERMAN	DATE 12/15/09			APPROVED BY ___ DATE ___
COST/SCHED AREA				APPROVED BY ___ DATE ___
SCALE AS NOTED				FIGURE NO. FIGURE 4 — REV 0

P:\GIS\PARRISISLAND_MCRD\MAPDOCS\MXD\FISH_TISSUE.AREA.MXD 12/15/09 SS

DRAWN BY T. WHEATON — DATE 08/25/09	NAVFAC	GENERAL'S LANDING CREEK -	CONTRACT NUMBER CTO 0387
CHECKED BY G. ZIMMERMAN — DATE 12/15/09		REFERENCE FISH TISSUE SAMPLE LOCATION	APPROVED BY — DATE
REVISED BY ___ — DATE ___		SITE 3 - CAUSEWAY LANDFILL	APPROVED BY ___ — DATE ___
SCALE AS NOTED		MCRD PARRIS ISLAND, SOUTH CAROLINA	FIGURE NO. FIGURE 5 — REV 0

SEDIMENT COCs	MAXIMUM CONCENTRATION IN SEDIMENT	BACKGROUND/TYPICAL FACILITY SEDIMENT CONCENTRATION (1)	U.S. EPA SCREENING LEVEL RESIDENTIAL SOIL (2)	REGION 4 EEV (3)
PAHs (ug/kg)				
BAP EQUIVALENTS (4)	262	NA	15	NA
TOTAL PAHs (5)	1991	NA	NA	1684
PESTICIDES (ug/kg)				
4,4'–DDD	58	33.6	2000	1.22
4,4'–DDE	26	31.6	1400	2.07
4,4'–DDT	12	34.5	1700	1.19
ALPHA–CHLORDANE	6.6	13.9	1600 (6)	0.5 (6)
GAMMA–CHLORDANE	3.4	13.2	1600 (6)	0.5 (6)
INORGANICS (mg/kg)				
ARSENIC	13.6	12.2	0.39	7.24
COPPER	27.1	10.1	3100	18.7
LEAD	44.9	20.6	400 (7)	30.2
MERCURY	0.2	0.09	23 (8)	0.13
ZINC	93.3	45	23000	124

1. BACKGROUND/TYPICAL FACILITY SEDIMENT CONCENTRATIONS TAKEN FROM SITE 1 RI/RFI (TtNUS, 2001). PESTICIDE VALUES ARE TYPICAL FACILITY CONCENTRATIONS.
2. REGIONIONAL SCREENING LEVELS FOR CHEMICALS AT SUPERFUND SITES, U.S. EPA, MAY 2009.
3. U.S. EPA REGION 4 ECOLOGICAL SCREENING TABLE (USEPA, 1998).
4. BAP EQUIVALENTS = BENZO(A)ANTHRACENE (0.1) + BENZO(A)PYRENE (0.1) + BENZO(B)FLUORANTHENE (0.1) + BENZO(K)FLUORANTHENE (0.01) + CHRYSENE (0.001) + DIBENZO (A,H)ANTHRACENE (0.1) + INDENO(1,2,3–CD)PYRENE (0.1).
5. TOTAL PAHS = LOW MOLECULAR WEIGHT PAHs + HIGH MOLECULAR WEIGHT PAHs.
   * LOW MOLECULAR WEIGHT = 2 METHYLNAPHTHALENE + ACENAPHTHENE + ACENAPHTHYLENE + ANTHRACENE + FLUORENE + NAPHTHALENE + PHENANTHRENE
   * HIGH MOLECULAR WEIGHT PAHs = BENZO(A)ANTHRACENE + BENZO(A)PYRENE + CHRYSENE + DIBENZO(A,H)ANTHRACENE + FLUORANTHENE + PYRENE.
   * IF A PAH IS DETECTED 1/2 THE DETECTION LIMIT SHOULD BE USED FOR NONDETECTED PAHs TO CALCULATE TOTAL PAHs AND BAP EQUIVALENTS.
6. BASED ON TOTAL CHLORDANE.
7. OSWER SOIL SCREENING LEVEL FOR RESIDENTIAL LAND USE (U.S. EPA, 1994).
8. VALUE IS FOR MECURIC CHLORIDE.

NA = NOT AVAILABLE
PAH = POLYNUCLEAR AROMATIC HYDROCARBON
BAP = BENZO(A)PYRENE

LEGEND:

- ● 1998 SEDIMENT SAMPLE LOCATION
- ■ 1999 SEDIMENT SAMPLE LOCATION
- ▲ 2001 SEDIMENT SAMPLE LOCATION
- △ 2003 SEDIMENT SAMPLE LOCATION
- 2001 EXTENT OF LANDFILL COVER
- TREE LINE 1998
- SEDIMENT COVER AREAS (2001)
- E EXCEEDES ECOLOGICAL CRITERIA AND BACKGROUND
- H EXCEEDES HUMAN HEALTH CRITERIA AND BACKGROUND
- J ESTIMATED
- mg/kg MILLIGRAMS PER KILOGRAM
- ug/kg MICROGRAMS PER KILOGRAM
- NA NOT ANALYZED
- ND NOT DETECTED

0 240 480
SCALE IN FEET

DRAWN BY CK	DATE 9-29-09	DETECTED CONCENTRATIONS IN SEDIMENT SITE 3 – CAUSEWAY LANDFILL MCRD PARRIS ISLAND, SOUTH CAROLINA	CONTRACT NO. 3920
CHECKED BY	DATE		OWNER NO.
REVISED BY	DATE		APPROVED BY / DATE
SCALE 1"=240'			DRAWING NO. FIGURE 6 / REV. 0

NAVFAC

R:\0106\0106TM01.dwg PIT CARLY.KRAMER 9/30/2009 10:19:41 AM

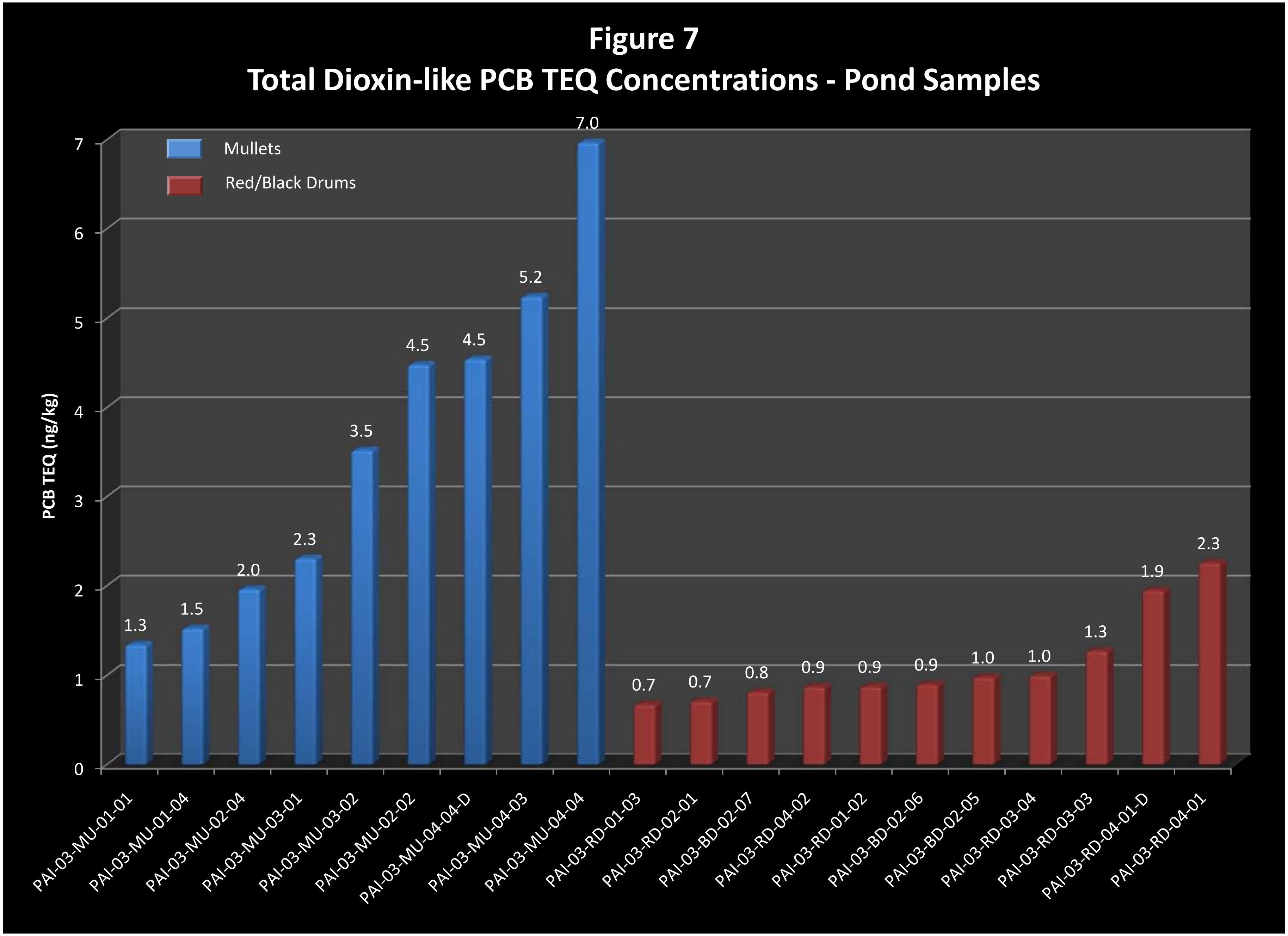
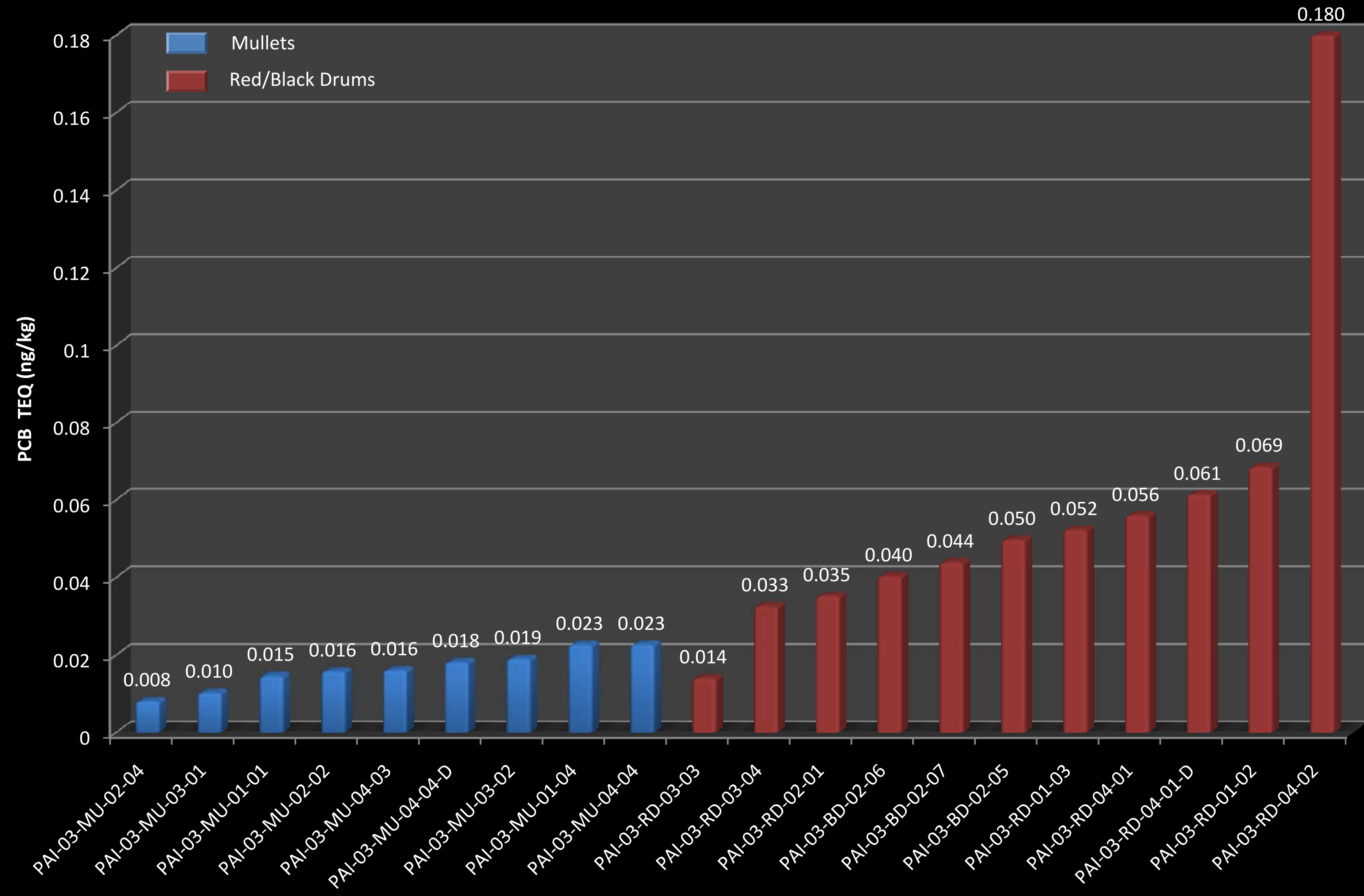


Figure 7
Total Dioxin-like PCB TEQ Concentrations - Pond Samples
Mullets
Red/Black Drums
PCB TEQ (ng/kg)
0
1
2
3
4
5
6
7
1.3
1.5
2.0
2.3
3.5
4.5
4.5
5.2
7.0
0.7
0.7
0.8
0.9
0.9
0.9
1.0
1.0
1.3
1.9
2.3
PAI-03-MU-01-01
PAI-03-MU-01-04
PAI-03-MU-02-04
PAI-03-MU-03-01
PAI-03-MU-03-02
PAI-03-MU-02-02
PAI-03-MU-04-04-D
PAI-03-MU-04-03
PAI-03-MU-04-04
PAI-03-RD-01-03
PAI-03-RD-02-01
PAI-03-BD-02-07
PAI-03-RD-04-02
PAI-03-RD-01-02
PAI-03-BD-02-06
PAI-03-BD-02-05
PAI-03-RD-03-04
PAI-03-RD-03-03
PAI-03-RD-04-01-D
PAI-03-RD-04-01

Figure 8
Lipid and Length Normalized Concentrations - Pond Samples



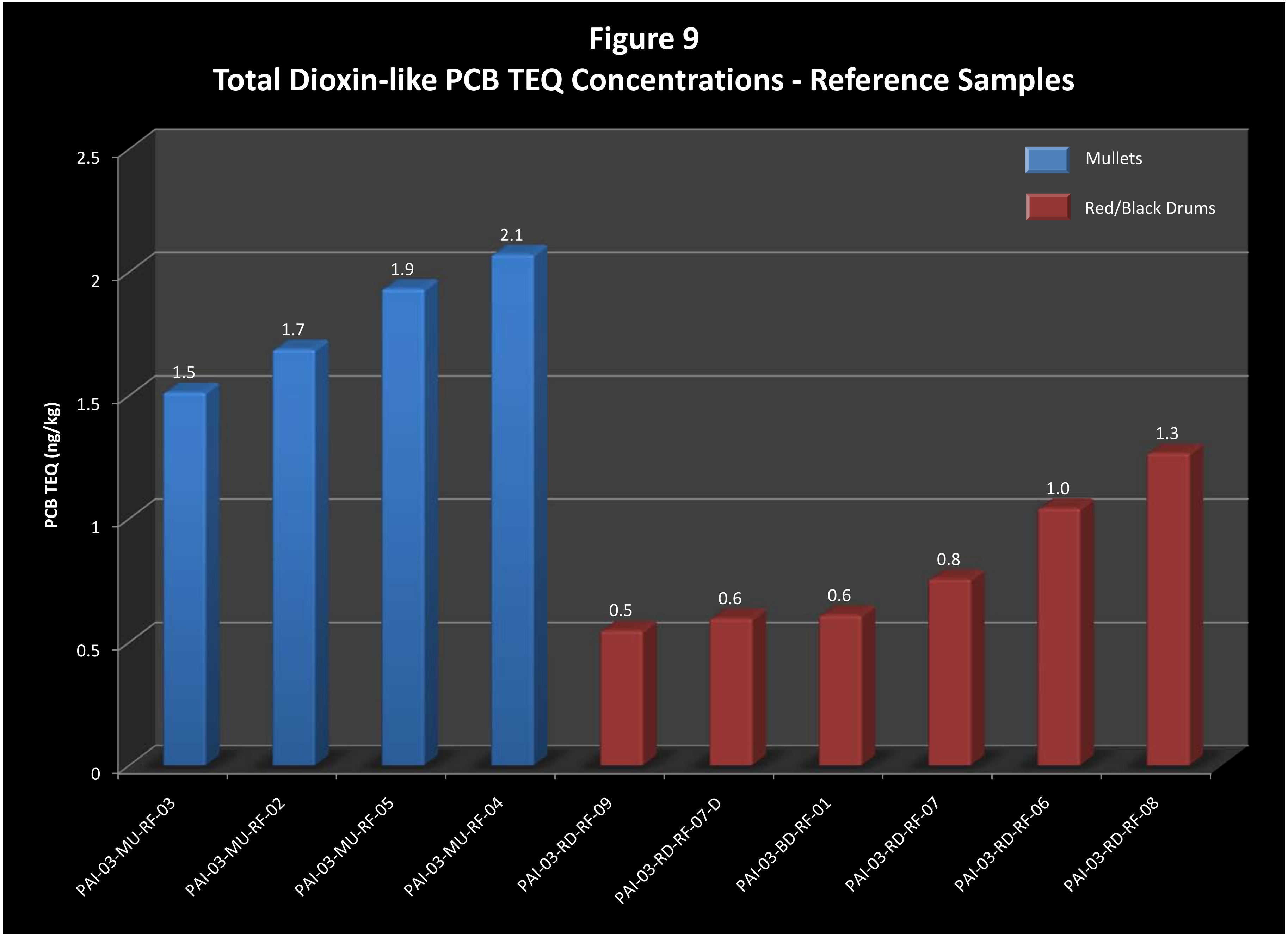


Figure 9
Total Dioxin-like PCB TEQ Concentrations - Reference Samples
PCB TEQ (ng/kg)
2.5
2
1.5
1
0.5
0
Mullets
Red/Black Drums
1.5
1.7
1.9
2.1
0.5
0.6
0.6
0.8
1.0
1.3
PAI-03-MU-RF-03
PAI-03-MU-RF-02
PAI-03-MU-RF-05
PAI-03-MU-RF-04
PAI-03-RD-RF-09
PAI-03-RD-RF-07-D
PAI-03-BD-RF-01
PAI-03-RD-RF-07
PAI-03-RD-RF-06
PAI-03-RD-RF-08

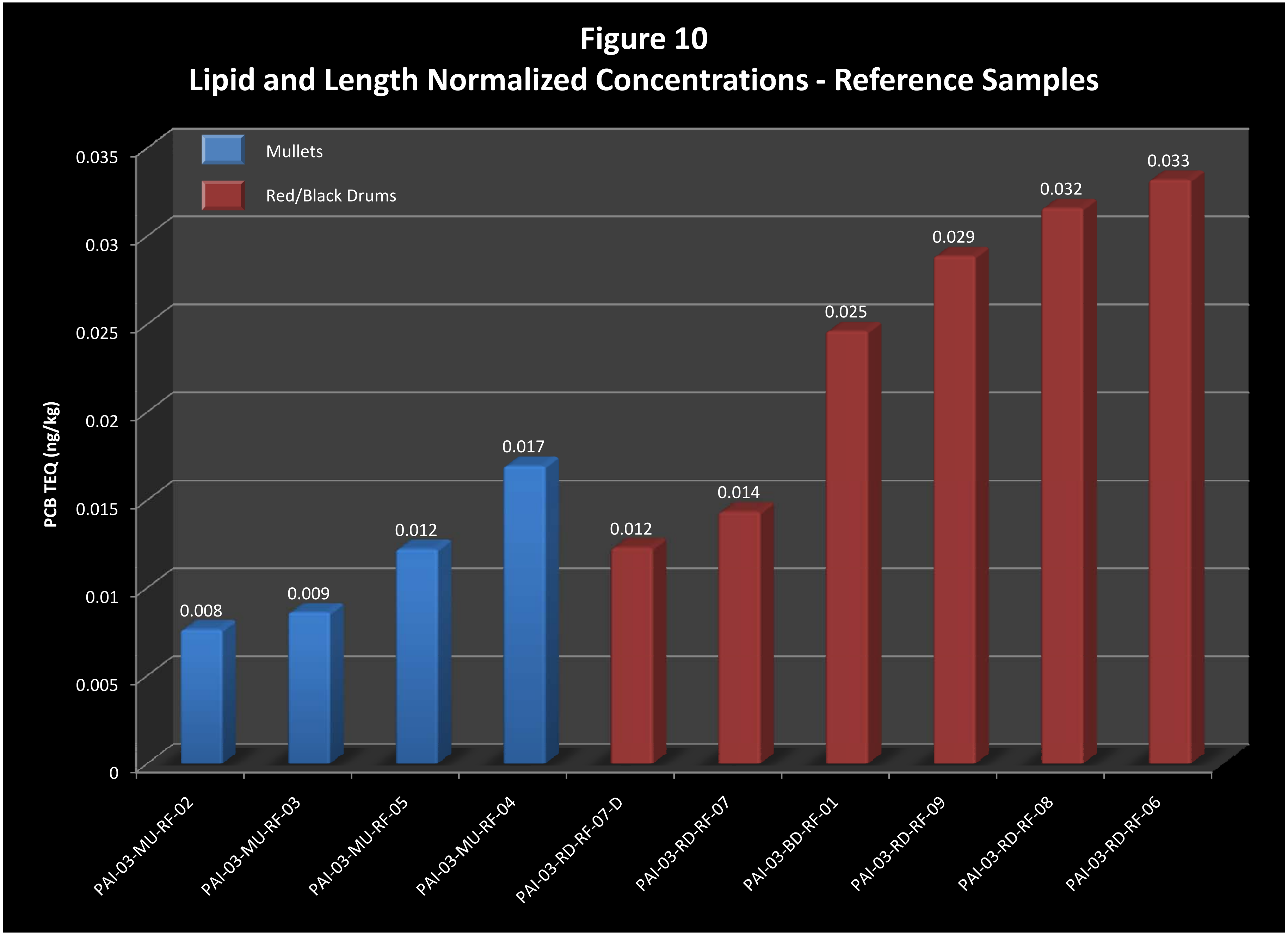


Figure 10
Lipid and Length Normalized Concentrations - Reference Samples
Mullets
Red/Black Drums
PCB TEQ (ng/kg)
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
0.008
0.009
0.012
0.017
0.012
0.014
0.025
0.029
0.032
0.033
PAI-03-MU-RF-02
PAI-03-MU-RF-03
PAI-03-MU-RF-05
PAI-03-MU-RF-04
PAI-03-RD-RF-07-D
PAI-03-RD-RF-07
PAI-03-BD-RF-01
PAI-03-RD-RF-09
PAI-03-RD-RF-08
PAI-03-RD-RF-06

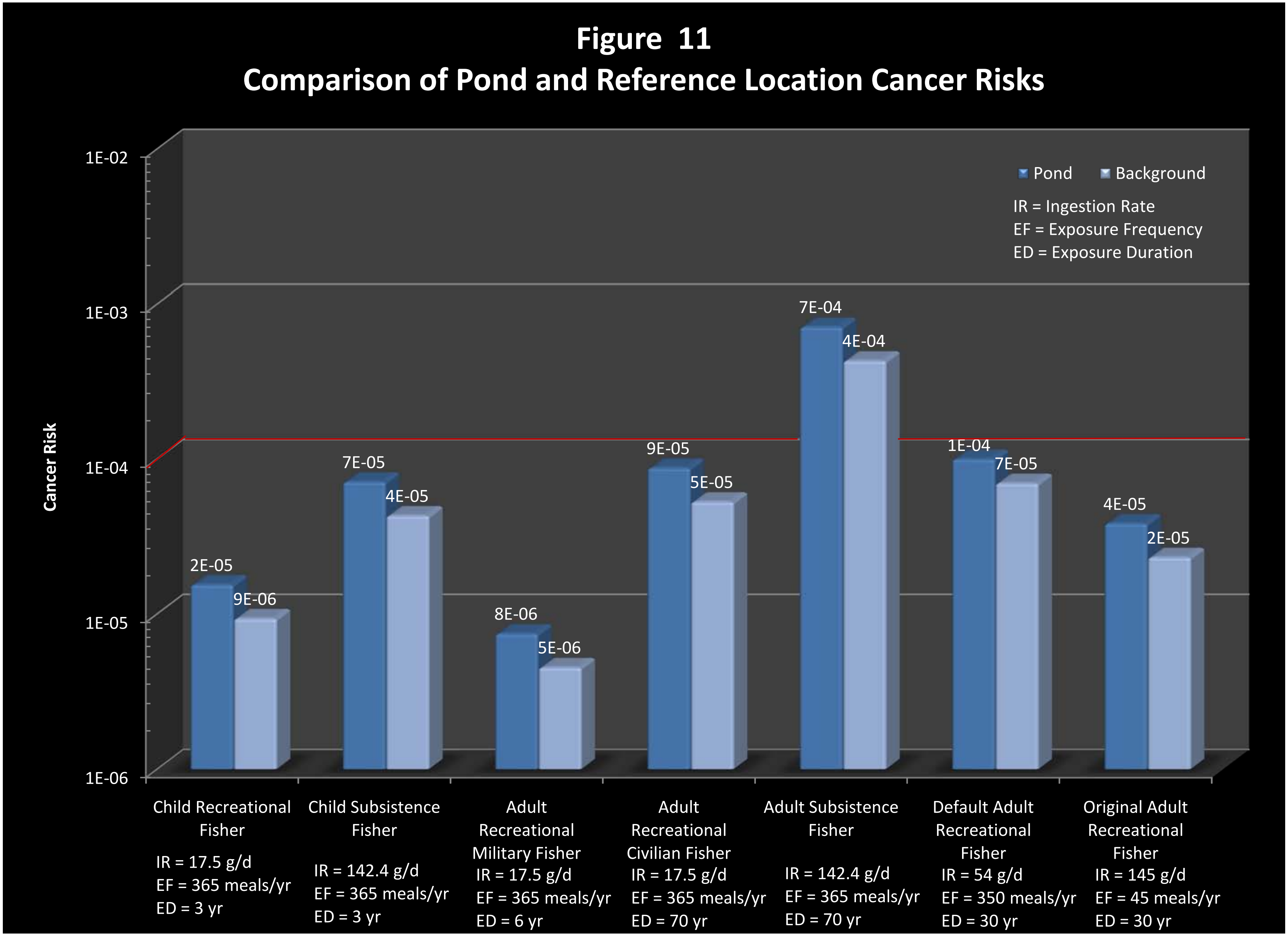


Figure 11
Comparison of Pond and Reference Location Cancer Risks
Pond
Background
IR = Ingestion Rate
EF = Exposure Frequency
ED = Exposure Duration
Cancer Risk
1E-02
1E-03
1E-04
1E-05
1E-06
2E-05
9E-06
7E-05
4E-05
8E-06
5E-06
9E-05
5E-05
7E-04
4E-04
1E-04
7E-05
4E-05
2E-05
Child Recreational Fisher
IR = 17.5 g/d
EF = 365 meals/yr
ED = 3 yr
Child Subsistence Fisher
IR = 142.4 g/d
EF = 365 meals/yr
ED = 3 yr
Adult Recreational Military Fisher
IR = 17.5 g/d
EF = 365 meals/yr
ED = 6 yr
Adult Recreational Civilian Fisher
IR = 17.5 g/d
EF = 365 meals/yr
ED = 70 yr
Adult Subsistence Fisher
IR = 142.4 g/d
EF = 365 meals/yr
ED = 70 yr
Default Adult Recreational Fisher
IR = 54 g/d
EF = 350 meals/yr
ED = 30 yr
Original Adult Recreational Fisher
IR = 145 g/d
EF = 45 meals/yr
ED = 30 yr

Figure 12

Comparison of Pond and Reference Location Hazard Indices

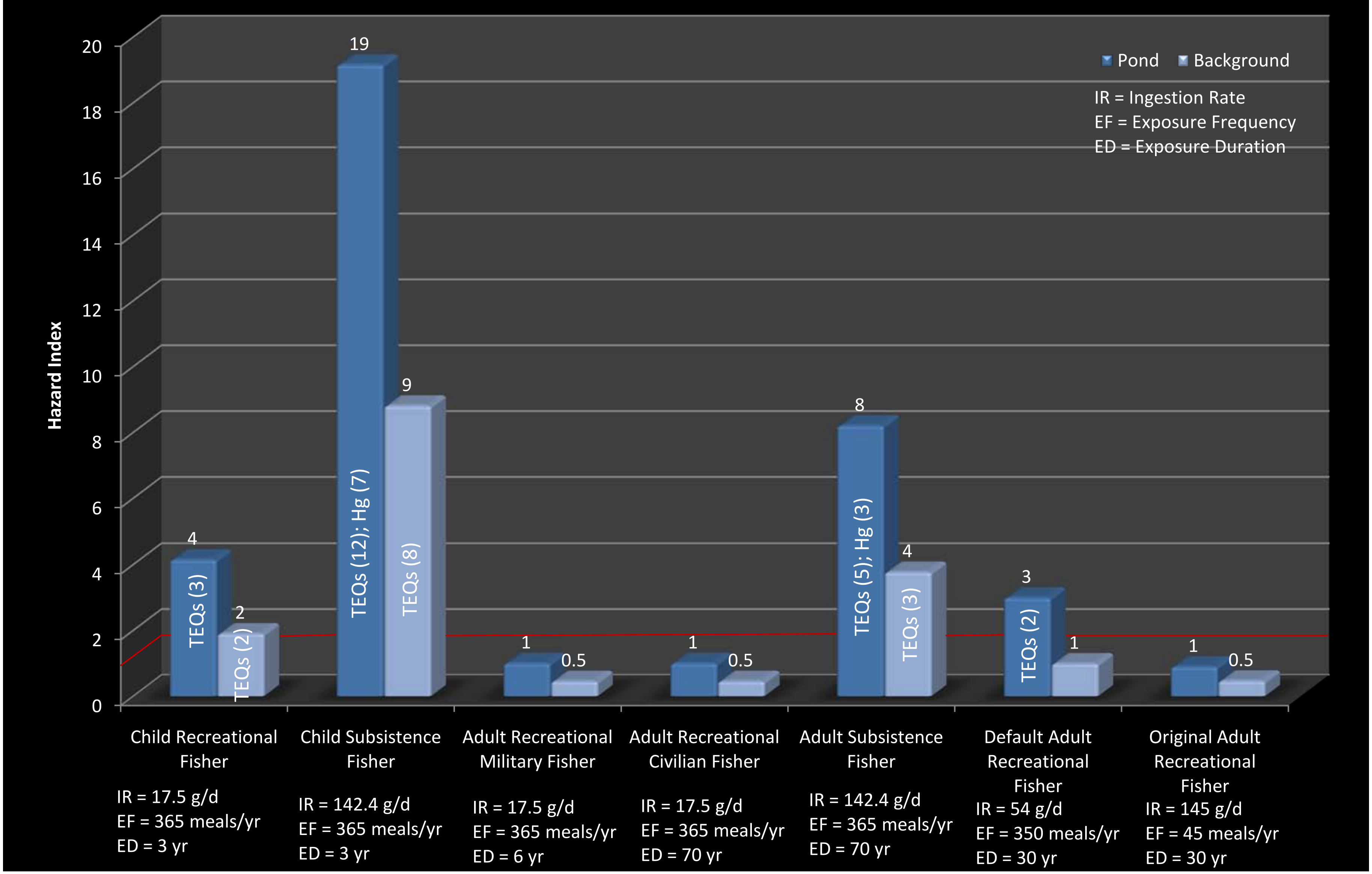
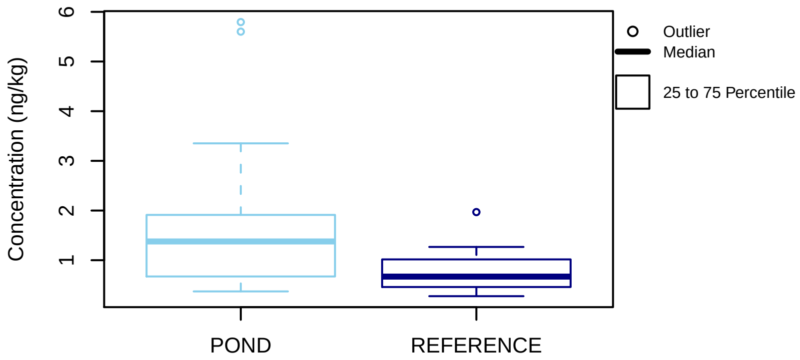
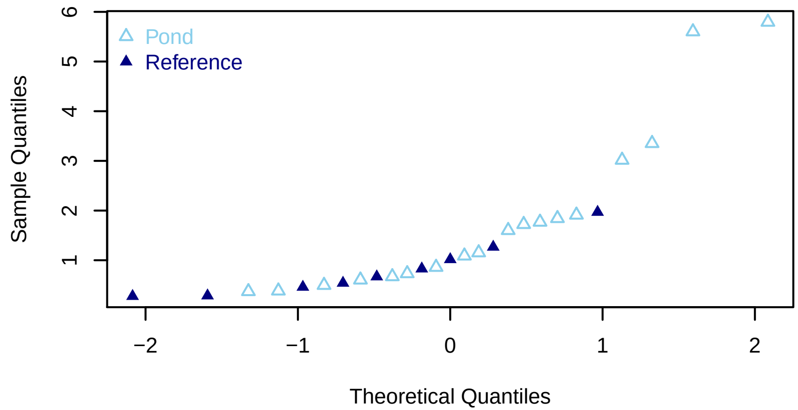


EXHIBIT 5−1
PCB TEQ
LIPID NORMALIZED
SITE/SWMU 3 − CAUSEWAY LANDFILL

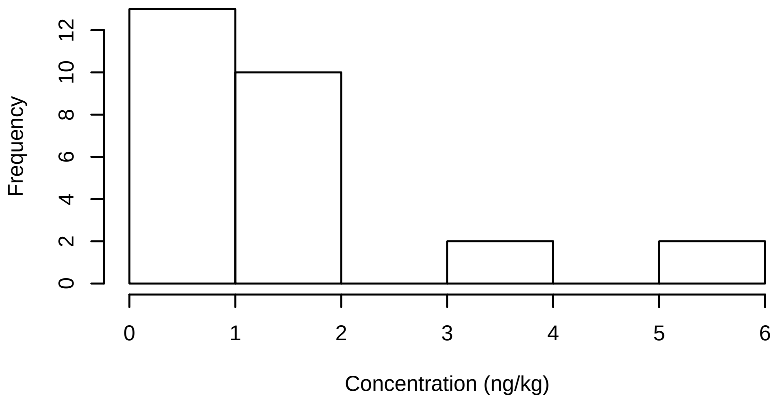
Box Plot



Normal Q−Q Plot



Histogram

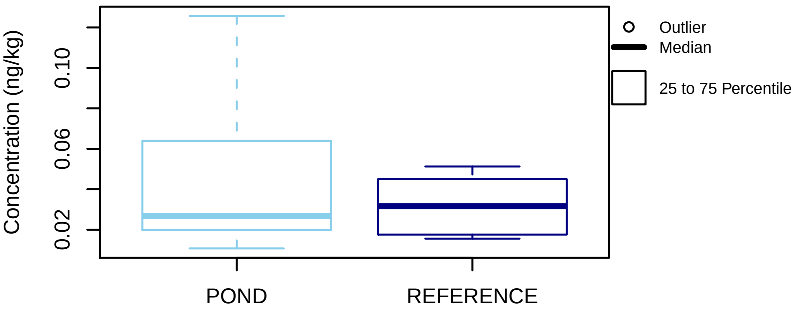


Summary Statistics

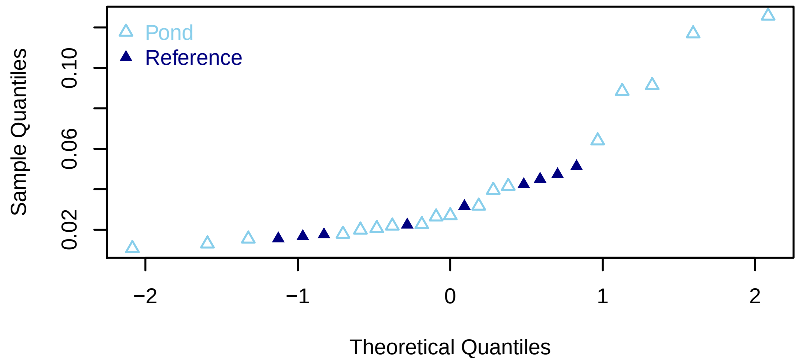
	Pond (ng/kg)	Reference (ng/kg)
Minimum	0.37	0.28
25th Percentile	0.69	0.46
Median	1.38	0.67
Mean	1.83	0.81
75th Percentile	1.89	1.02
Maximum	5.79	1.97

EXHIBIT 5−2
PCB TEQ
LENGTH NORMALIZED
SITE/SWMU 3 − CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

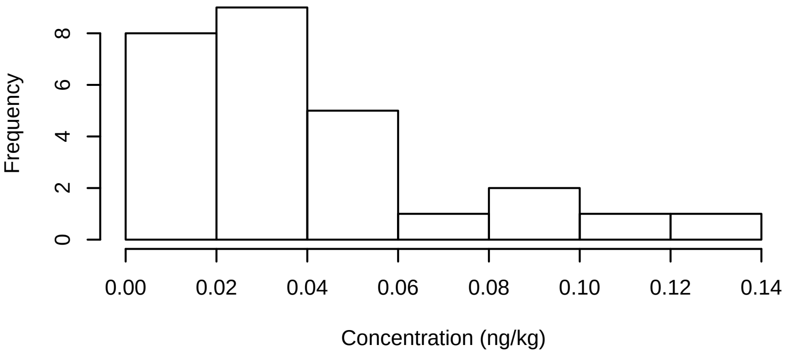
Box Plot



Normal Q−Q Plot



Histogram

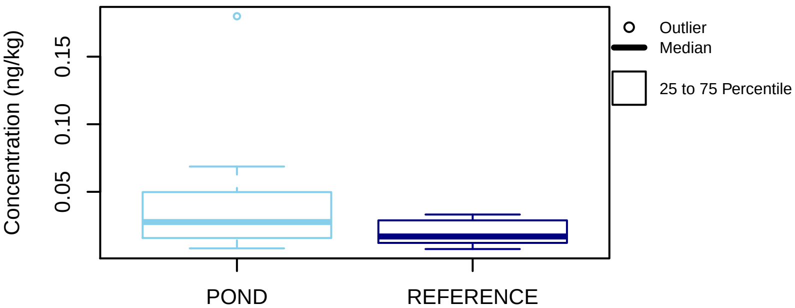


Summary Statistics

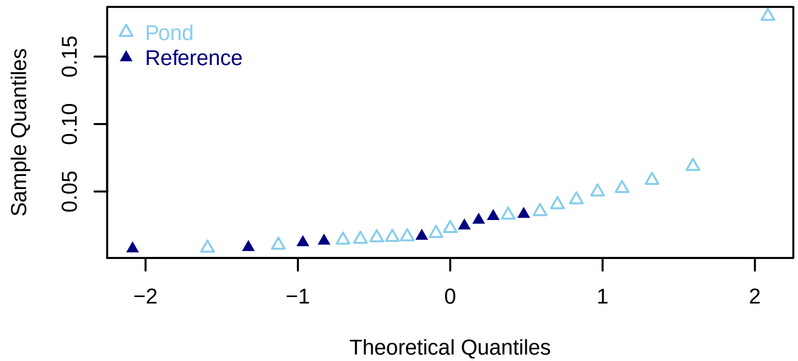
	Pond (ng/kg)	Reference (ng/kg)
Minimum	0.01	0.02
25th Percentile	0.02	0.02
Median	0.03	0.03
Mean	0.04	0.03
75th Percentile	0.06	0.05
Maximum	0.13	0.05

EXHIBIT 5−3
PCB TEQ
LIPID AND LENGTH NORMALIZED
SITE/SWMU 3 − CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

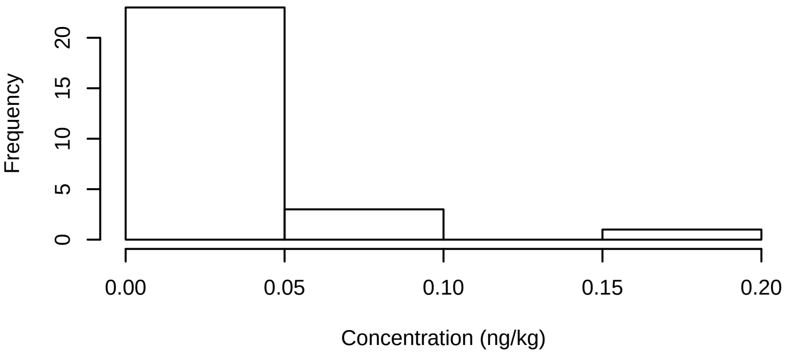
Box Plot



Normal Q−Q Plot



Histogram



Summary Statistics

	Pond (ng/kg)	Reference (ng/kg)
Minimum	0.01	0.01
25th Percentile	0.02	0.01
Median	0.03	0.02
Mean	0.04	0.02
75th Percentile	0.05	0.03
Maximum	0.18	0.03

APPENDIX A

FIELD FORMS

A-1 2001 FIELD INVESTIGATION

A-2 2003 FIELD INVESTIGATION

A-3 2009 FIELD INVESTIGATION

A-1 2001 FIELD INVESTIGATION

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER PAI- 101501 | PAGE 1 OF 2

PROJECT NO:	SITE NAME:	PROJECT MANAGER AND PHONE NUMBER	LABORATORY NAME AND CONTACT:
N3920	PAI SITE 3	D. BRAYACK 412 921 8375	KATAHDIN / A. COLBY

SAMPLERS (SIGNATURE): SJ Conti

FIELD OPERATIONS LEADER AND PHONE NUMBER: S J CONTI 412 921 8422

ADDRESS: 340 COUNTY RD 5

CARRIER/WAYBILL NUMBER: FED EX AB# 8243 8234 8467

CITY, STATE: WESTBROOK, ME. 04092

STANDARD TAT ☐
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G | G | G | G

PRESERVATIVE USED: 4°C | 4°C | 4°C | 4°C

TYPE OF ANALYSIS: TCL PAH / SELECT METALS (4 OZ) | SELECT PEST / TCL PCBS (4 OZ) | SELECT METALS / TCL PCBS (4 OZ) | SELECT METALS / SELECT PEST (4 OZ)

DATE YEAR 2001	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	TCL PAH / SELECT METALS (4 OZ)	SELECT PEST / TCL PCBS (4 OZ)		SELECT METALS / TCL PCBS (4 OZ)		SELECT METALS / SELECT PEST (4 OZ)			COMMENTS
10/15	1640	PAI 03 SD 53 01	SED	G	1						1			
"	1650	PAI 03 SD 54 01	"	"	1						1			
"	1700	PAI 03 SD 55 01	"	"	1						1			
"	1740	PAI 03 SD 52 01	"	"	1				1					
"	1750	PAI 03 SD 51 01	"	"	1				1					
"	1800	PAI 03 SD 50 01	"	"	1				1					
10/16	0800	PAI 03 SD 47 01	"	"	1	1								
"	0830	PAI 03 SD 48 01	"	"	1	1								
"	0900	PAI 03 SD 49 01	"	"	1	1								
"	0910	PAI 03 SD 46 01	"	"	1	1								
"	1025	PAI 03 SD 56-01	"	"	1						1			
"	1030	PAI 03 SD 57-01	"	"	1						1			
"	1035	PAI 03 SD 58-01	"	"	1						1			

10/15/01
10/16/01

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY SJ Conti	10/17/01	1400	1. RECEIVED BY FED EX		
2. RELINQUISHED BY			2. RECEIVED BY		
3. RELINQUISHED BY			3. RECEIVED BY		

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY) 3/99

FORM NO. TNUS-001

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER PAI- 101501 | PAGE 2 OF 2

PROJECT NO:	SITE NAME:	PROJECT MANAGER AND PHONE NUMBER	LABORATORY NAME AND CONTACT:
N 3920	PAI SITE 3	D. BRAYACK 412 921 8375	KATAHDIN / A. COLBY

SAMPLERS (SIGNATURE): SJ Conti

FIELD OPERATIONS LEADER AND PHONE NUMBER: S. CONTI 412 921 8422

ADDRESS: 340 COUNTY RD 5

CARRIER/WAYBILL NUMBER: FED EX AB # 824382348467

CITY, STATE: WESTBROOK, ME. 04092

STANDARD TAT ☐
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G, G, G, G

PRESERVATIVE USED: 4°C, 4°C, 4°C, 4°C

TYPE OF ANALYSIS: TCL PAHs/SELECT METALS (4oz); SELECT PEST/TCL PCBs (4oz); SELECT METALS/TCL PCBs (4oz); SELECT METALS/SELECT PEST (4oz)

DATE YEAR 2001	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	TCL PAHs/SELECT METALS (4oz)	SELECT PEST/TCL PCBs (4oz)	SELECT METALS/TCL PCBs (4oz)	SELECT METALS/SELECT PEST (4oz)			COMMENTS
10/16	1040	PAI-03-SD-59-01	SED	G	1				1			
"	1050	PAI 03 SD 60-01	"	"	1				1			
"	1320	PAI 03 SD 45-01	"	"	2	1	1					
"	0000	PAI DUP 101601-1	"	"	4*	2	2					DUP OF SD 45 DO/MS/MSD ALSO
"	1345	PAI 03 SD 41-01	"	"	2	1	1					
"	0000	PAI DUP 101601-2	"	"	2	1	1					DUP OF SD 41 DUP
"	1400	PAI 03 SD 43-01	"	"	2	1	1					
"	1420	PAI 03 SD 44-01	"	"	2	1	1					
"	1440	PAI 03 SD 42-01	"	"	2	1	1					

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY SJ Conti	10/17/01	1400	1. RECEIVED BY FED EX		
2. RELINQUISHED BY			2. RECEIVED BY		
3. RELINQUISHED BY			3. RECEIVED BY		

COMMENTS: * TOOK DOUBLE VOL. HERE - FOR DUP & MS/MSD

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

3/99
FORM NO. TtNUS-001

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: Parris Island-Site 3
Project No.: CTO-150---N3920

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: PAI-03-SD- 41-01
Sample Location: PAI-03-SD- 41
Sampled By: MW/JB
C.O.C. No.: PAI- 101501

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 10/16/01 Time: 1345 Method: SS SPOON Monitor Reading (ppm): -	0-0.5	GRAY	SANDY SILT - SATURATED

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

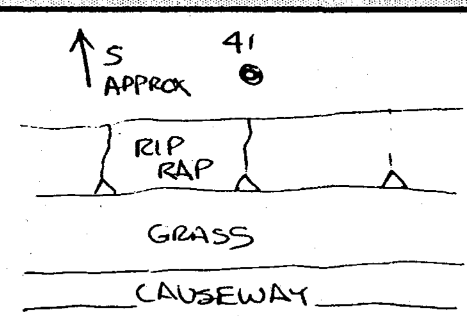
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL PAH's/SELECT METALS	1-4-OZ JAR/Cool 4°C	✓	
SELECT PEST/ TCL PCB's	1-4-OZ JAR/Cool 4°C	✓	
SELECT METALS/TCL PCB's	1-4-OZ JAR/Cool 4°C		
SELECT METALS/SELECT PEST	1-4-OZ JAR/Cool 4°C		

OBSERVATIONS / NOTES:

TOOK DUP HERE

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:
	PAI DUP 101601-2

Signature(s): SJ Conti

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	Parris Island-Site 3	Sample ID No.:	PAI-03-SD-~~46~~ 42-01
Project No.:	CTO-150---N3920	Sample Location:	PAI-03-SD-~~46~~ 42
		Sampled By:	MW/JB
		C.O.C. No.:	PAI- 101501

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 10/16/01	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time: 1440	0-0.5	BRN GRAY	SANDY SILT - SATURATED
Method: SSSPOON/BOWL			
Monitor Reading (ppm):			

COMPOSITE SAMPLE DATA:

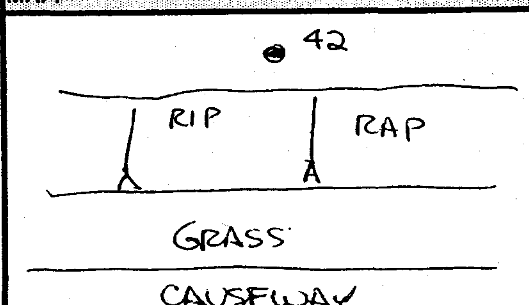
Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL PAH's/SELECT METALS	1-4-OZ JAR/Cool 4°C	✓	
SELECT PEST/ TCL PCB's	1-4-OZ JAR/Cool 4°C	✓	
SELECT METALS/TCL PCB's	1-4-OZ JAR/Cool 4°C		
SELECT METALS/SELECT PEST	1-4-OZ JAR/Cool 4°C		

OBSERVATIONS / NOTES:

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

SJ Conti

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	Parris Island-Site 3	Sample ID No.:	PAI-03-SD- 43-01
Project No.:	CTO-150---N3920	Sample Location:	PAI-03-SD- 43
		Sampled By:	MW/JB
		C.O.C. No.:	PAI- 101501

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 10/16/01 Time: 1400 Method: SS SPOON. Monitor Reading (ppm):	0-0.5'	GRAY	SANDY SILT - SATURATED

COMPOSITE SAMPLE DATA:

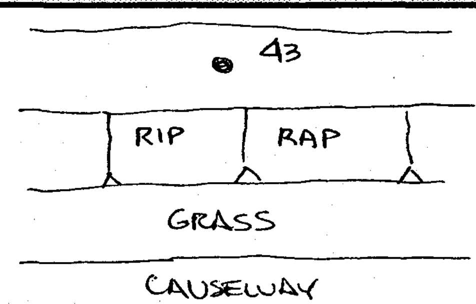
	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL PAH's/SELECT METALS	1-4-OZ JAR/Cool 4°C	✓	
SELECT PEST/ TCL PCB's	1-4-OZ JAR/Cool 4°C	✓	
SELECT METALS/TCL PCB's	1-4-OZ JAR/Cool 4°C		
SELECT METALS/SELECT PEST	1-4-OZ JAR/Cool 4°C		

OBSERVATIONS / NOTES:

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

SJ Conte

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page 1 of 1

Project Site Name:	Parris Island-Site 3	Sample ID No.:	PAI-03-SD- 44-01
Project No.:	CTO-150---N3920	Sample Location:	PAI-03-SD- 44
		Sampled By:	MW/JB
		C.O.C. No.:	PAI- 101501

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 10/16/01 Time: 1420 Method: SS SPOON Monitor Reading (ppm):	0-0.5	GRAY	SANDY SILT SATURATED

COMPOSITE SAMPLE DATA:

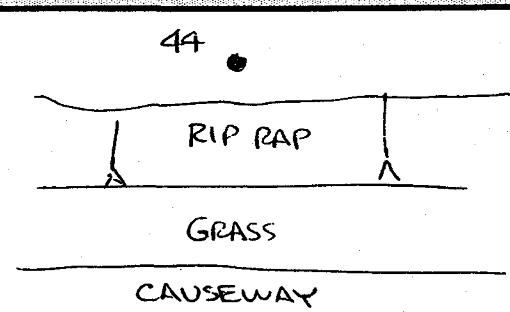
Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL PAH's/SELECT METALS	1-4-OZ JAR/Cool 4°C	✓	
SELECT PEST/ TCL PCB's	1-4-OZ JAR/Cool 4°C	✓	
SELECT METALS/TCL PCB's	1-4-OZ JAR/Cool 4°C		
SELECT METALS/SELECT PEST	1-4-OZ JAR/Cool 4°C		

OBSERVATIONS / NOTES:

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): SJ Conti

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	Parris Island-Site 3	Sample ID No.:	PAI-03-SD-45-01
Project No.:	CTO-150---N3920	Sample Location:	PAI-03-SD-45
		Sampled By:	JB/MW
		C.O.C. No.:	PAI-101501

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 10/16/01 Time: 1320 Method: SS SPOON Monitor Reading (ppm):	0-0.5	GRAY	SANDY SILT/SILTY SAND

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

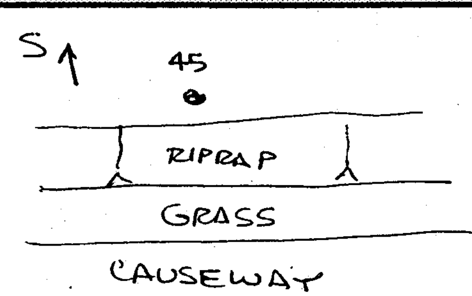
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL PAH's/SELECT METALS	1-4-OZ JAR/Cool 4°C	✓	
SELECT PEST/ TCL PCB's	1-4-OZ JAR/Cool 4°C	✓	
SELECT METALS/TCL PCB's	1-4-OZ JAR/Cool 4°C		
SELECT METALS/SELECT PEST	1-4-OZ JAR/Cool 4°C		

OBSERVATIONS / NOTES:

NO WATER

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.: PAI DUP 101601-1

Signature(s): SJ Conti

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: Parris Island-Site 3
Project No.: CTO-150---N3920

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: PAI-03-SD-46-01
Sample Location: PAI-03-SD-46
Sampled By: MW/JB
C.O.C. No.: PAI- 101501

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 10-16-01 Time: 0910 Method: SS BOWL/TROWEL Monitor Reading (ppm):	0-0.5		

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

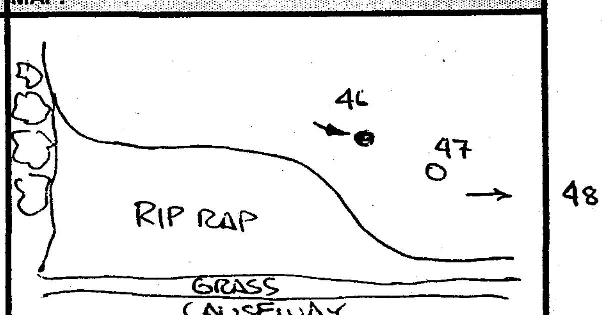
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL PAH's/SELECT METALS	1-4-OZ JAR/Cool 4°C	✓	
SELECT PEST/ TCL PCB's	1-4-OZ JAR/Cool 4°C		
SELECT METALS/TCL PCB's	1-4-OZ JAR/Cool 4°C		
SELECT METALS/SELECT PEST	1-4-OZ JAR/Cool 4°C		

OBSERVATIONS / NOTES:

3' WATER ±
@ LOCATION
@ 0910

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

SJ Conti

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	Parris Island-Site 3	Sample ID No.:	PAI-03-SD-4~~8~~7-01
Project No.:	CTO-150---N3920	Sample Location:	PAI-03-SD-4~~8~~7
		Sampled By:	MW/JB
		C.O.C. No.:	PAI-101501

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 10/16/01 Time: 0800 Method: SS BOWL/TROWEL SPOON Monitor Reading (ppm):	0-0.5'	GRAY	SANDY SILT - SATURATED

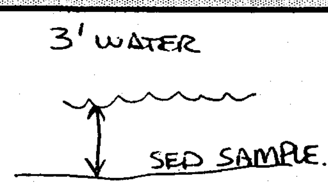
COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL PAH's/SELECT METALS	1-4-OZ JAR/Cool 4°C	✓	
SELECT PEST/ TCL PCB's	1-4-OZ JAR/Cool 4°C		
SELECT METALS/TCL PCB's	1-4-OZ JAR/Cool 4°C		
SELECT METALS/SELECT PEST	1-4-OZ JAR/Cool 4°C		

OBSERVATIONS / NOTES:



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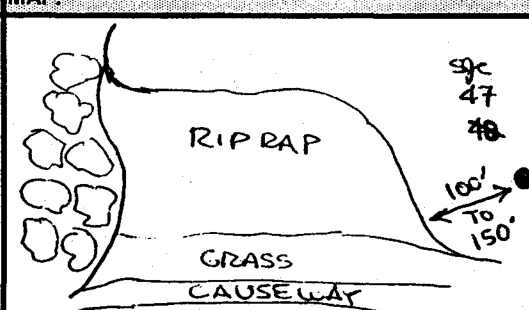


Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): SJ Conti

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page 1 of 1

Project Site Name:	Parris Island-Site 3	Sample ID No.:	PAI-03-SD- ~~49~~ 48 -01
Project No.:	CTO-150---N3920	Sample Location:	PAI-03-SD- ~~48~~ 48 SK
		Sampled By:	MW/JB
		C.O.C. No.:	PAI- 101501

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 10/16/01 Time: 0830 Method: SS BOWL/SPOON Monitor Reading (ppm):	0-0.5	GRAY	SANDY SILT - SATURATED

COMPOSITE SAMPLE DATA:

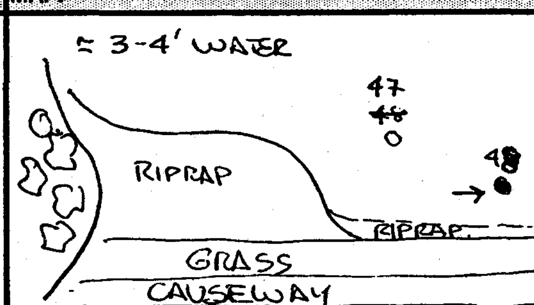
Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL PAH's/SELECT METALS	1-4-OZ JAR/Cool 4°C	✓	
SELECT PEST/ TCL PCB's	1-4-OZ JAR/Cool 4°C		
SELECT METALS/TCL PCB's	1-4-OZ JAR/Cool 4°C		
SELECT METALS/SELECT PEST	1-4-OZ JAR/Cool 4°C		

OBSERVATIONS / NOTES:

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

SJ Conti

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: Parris Island-Site 3
Project No.: CTO-150---N3920

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: PAI-03-SD- 49-01
Sample Location: PAI-03-SD- 49
Sampled By: MW/JB
C.O.C. No.: PAI- 101501

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 10/16/01 Time: 0900 Method: SS BOWL/SPOON Monitor Reading (ppm):	0–0.5'	GRAY BROWN	SANDY SILT – SATURATED

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

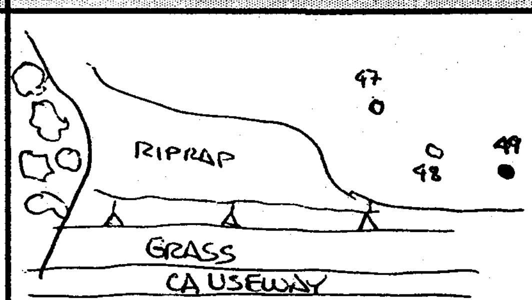
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL PAH's/SELECT METALS	1-4-OZ JAR/Cool 4°C	✓	
SELECT PEST/ TCL PCB's	1-4-OZ JAR/Cool 4°C		
SELECT METALS/TCL PCB's	1-4-OZ JAR/Cool 4°C		
SELECT METALS/SELECT PEST	1-4-OZ JAR/Cool 4°C		

OBSERVATIONS / NOTES:

2.0 → 2.5' WATER

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s): SJ Conti

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: Parris Island-Site 3
Project No.: CTO-150---N3920

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: PAI-03-SD- 50-01
Sample Location: PAI-03-SD- 50
Sampled By: SJC/JB
C.O.C. No.: PAI- 101501

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 10/15/01	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time: 1800	0-0.5		
Method: SS BOWL/TROWEL SPOON			
Monitor Reading (ppm): --			

COMPOSITE SAMPLE DATA:

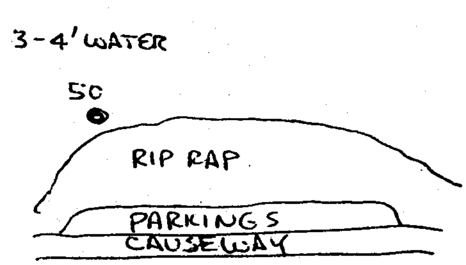
Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL PAH's/SELECT METALS	1-4-OZ JAR/Cool 4°C		
SELECT PEST/ TCL PCB's	1-4-OZ JAR/Cool 4°C		
SELECT METALS/TCL PCB's	1-4-OZ JAR/Cool 4°C	✓	
SELECT METALS/SELECT PEST	1-4-OZ JAR/Cool 4°C		

OBSERVATIONS / NOTES:

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s): SJ Conti

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	Parris Island-Site 3	Sample ID No.:	PAI-03-SD-51-01
Project No.:	CTO-150---N3920	Sample Location:	PAI-03-SD-51
		Sampled By:	SJC/JB
		C.O.C. No.:	PAI-101501

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 10/15/01 Time: 1750 Method: SS BOWL/TROWEL SPOON Monitor Reading (ppm):	0-0.5	GRAY	SILT - SATURATED.

COMPOSITE SAMPLE DATA:

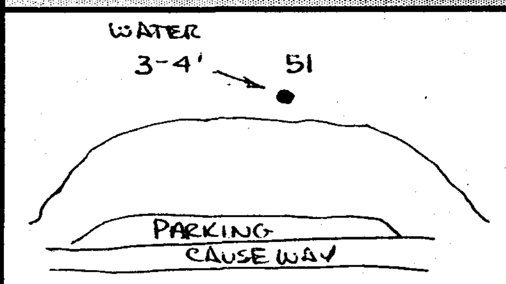
Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL PAH's/SELECT METALS	1-4-OZ JAR/Cool 4°C		
SELECT PEST/ TCL PCB's	1-4-OZ JAR/Cool 4°C		
SELECT METALS/TCL PCB's	1-4-OZ JAR/Cool 4°C	✓	
SELECT METALS/SELECT PEST	1-4-OZ JAR/Cool 4°C		

OBSERVATIONS / NOTES:

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s): SJ Conti

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	Parris Island-Site 3	Sample ID No.:	PAI-03-SD-52-01
Project No.:	CTO-150---N3920	Sample Location:	PAI-03-SD-52
		Sampled By:	JB/SJC
		C.O.C. No.:	PAI-101501

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other: ______
[] QA Sample Type: ______

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 10/15/01 Time: 1740 Method: SS BOWL/TROWEL/SPOON Monitor Reading (ppm):	0-0.5'	GRAY BRN	SILT SATURATED

COMPOSITE SAMPLE DATA:

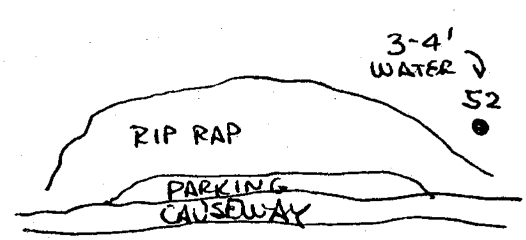
Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL PAH's/SELECT METALS	1-4-OZ JAR/Cool 4°C		
SELECT PEST/ TCL PCB's	1-4-OZ JAR/Cool 4°C		
SELECT METALS/TCL PCB's	1-4-OZ JAR/Cool 4°C	✓	
SELECT METALS/SELECT PEST	1-4-OZ JAR/Cool 4°C		

OBSERVATIONS / NOTES:

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

SJ Conti

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SOIL & SEDIMENT SAMPLE LOG SHEET

Page 1 of 1

Project Site Name:	Parris Island-Site 3	Sample ID No.:	PAI-03-SD- 53-01
Project No.:	CTO-150---N3920	Sample Location:	PAI-03-SD- 53
		Sampled By:	JD/SJC
		C.O.C. No.:	PAI- 101501

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 10/15/01 Time: 1640 Method: SS BOWL/SPOON Monitor Reading (ppm):	0-0.5'	GRAY	SILT - SATURATED

COMPOSITE SAMPLE DATA:

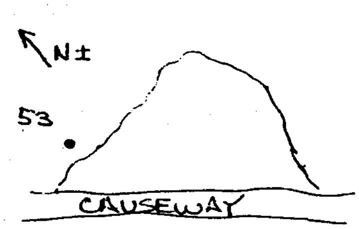
Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL PAH's/SELECT METALS	1-4-OZ JAR/Cool 4°C		
SELECT PEST/ TCL PCB's	1-4-OZ JAR/Cool 4°C		
SELECT METALS/TCL PCB's	1-4-OZ JAR/Cool 4°C		
SELECT METALS/SELECT PEST	1-4-OZ JAR/Cool 4°C	✓	

OBSERVATIONS / NOTES:

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

SJ Conti

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page 1 of 1

Project Site Name: Parris Island-Site 3
Project No.: CTO-150---N3920

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: PAI-03-SD- 54-01
Sample Location: PAI-03-SD- 54
Sampled By: JB/SJC
C.O.C. No.: PAI- 101501

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 10/15/01 Time: 1650 Method: SS SPOON/BOWL Monitor Reading (ppm): —	0-0.5'	GRAY	SILT SATURATED

COMPOSITE SAMPLE DATA:

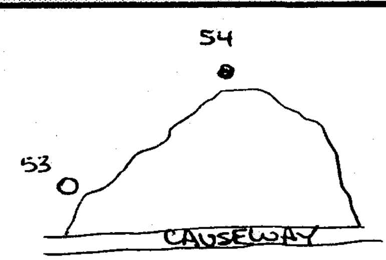
	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL PAH's/SELECT METALS	1-4-OZ JAR/Cool 4°C		
SELECT PEST/ TCL PCB's	1-4-OZ JAR/Cool 4°C		
SELECT METALS/TCL PCB's	1-4-OZ JAR/Cool 4°C		
SELECT METALS/SELECT PEST	1-4-OZ JAR/Cool 4°C	✓	

OBSERVATIONS / NOTES:

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s): SJ Conti

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: Parris Island-Site 3
Project No.: CTO-150--N3920

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: PAI-03-SD-55-01
Sample Location: PAI-03-SD-55
Sampled By: JB/SJC
C.O.C. No.: PAI-101501

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 10/15/01 Time: 1700 Method: SS BOWL/SPOON Monitor Reading (ppm):	0-0.5'	GRAY	SILT SATURATED

COMPOSITE SAMPLE DATA:

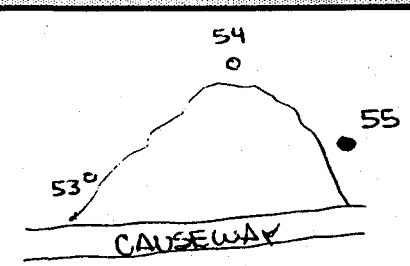
Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL PAH's/SELECT METALS	1-4-OZ JAR/Cool 4°C		
SELECT PEST/ TCL PCB's	1-4-OZ JAR/Cool 4°C		
SELECT METALS/TCL PCB's	1-4-OZ JAR/Cool 4°C		
SELECT METALS/SELECT PEST	1-4-OZ JAR/Cool 4°C	✓	

OBSERVATIONS / NOTES:

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s): SJ Conti

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	Parris Island-Site 3	Sample ID No.:	PAI-03-SD-56-01
Project No.:	CTO-150---N3920	Sample Location:	PAI-03-SD-56
		Sampled By:	MW/JB
		C.O.C. No.:	PAI-101501

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 10/16/01 Time: 1025 Method: SS BOWL/SPOON Monitor Reading (ppm):	0-0.5	BROWN	SANDY SILT - SATURATED

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

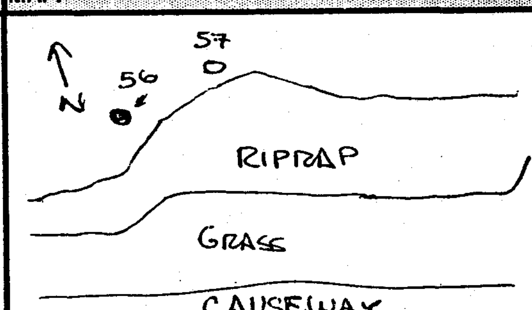
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL PAH's/SELECT METALS	1-4-OZ JAR/Cool 4°C		
SELECT PEST/ TCL PCB's	1-4-OZ JAR/Cool 4°C		
SELECT METALS/TCL PCB's	1-4-OZ JAR/Cool 4°C		
SELECT METALS/SELECT PEST	1-4-OZ JAR/Cool 4°C	✓	

OBSERVATIONS / NOTES:

≃ 4 TO 6" OF WATER.

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

SJ Conti

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SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: Parris Island-Site 3
Project No.: CTO-150---N3920

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: PAI-03-SD- 57-01
Sample Location: PAI-03-SD- 57
Sampled By: MW/JB
C.O.C. No.: PAI- 101501

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 10/16/01 Time: 1030 Method: SS ~~Bowl~~/SPOON Monitor Reading (ppm):	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
	0-0.5	DK BRN	SANDY SITL- MOIST

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

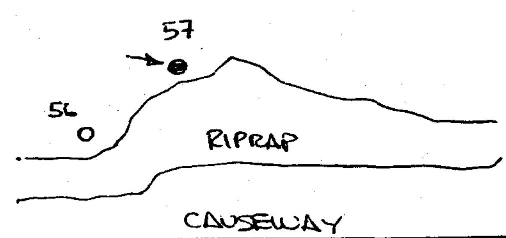
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL PAH's/SELECT METALS	1-4-OZ JAR/Cool 4°C		
SELECT PEST/ TCL PCB's	1-4-OZ JAR/Cool 4°C		
SELECT METALS/TCL PCB's	1-4-OZ JAR/Cool 4°C		
SELECT METALS/SELECT PEST	1-4-OZ JAR/Cool 4°C	✓	

OBSERVATIONS / NOTES:

NO WATER.

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s): SJ Conta

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	Parris Island-Site 3	Sample ID No.:	PAI-03-SD-58-01
Project No.:	CTO-150---N3920	Sample Location:	PAI-03-SD-58
		Sampled By:	MW/JB
		C.O.C. No.:	PAI-101501

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 10/16/01 Time: 1035 Method: SS BOWL/SPOON Monitor Reading (ppm):	0-0.5	D. BRN	SANDY SILT- SATURATED

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

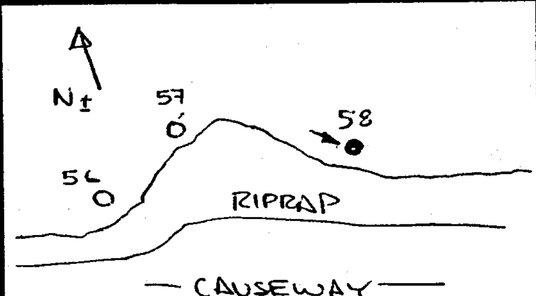
Analysis	Container Requirements	Collected	Other
TCL PAH's/SELECT METALS	1-4-OZ JAR/Cool 4°C		
SELECT PEST/ TCL PCB's	1-4-OZ JAR/Cool 4°C		
SELECT METALS/TCL PCB's	1-4-OZ JAR/Cool 4°C		
SELECT METALS/SELECT PEST	1-4-OZ JAR/Cool 4°C	✓	

OBSERVATIONS / NOTES:

8" WATER HERE

[SULFUR ODOR]

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s): SJ Conte

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: Parris Island-Site 3
Project No.: CTO-150---N3920

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: PAI-03-SD- 59-01
Sample Location: PAI-03-SD- 59
Sampled By: MW/JB
C.O.C. No.: PAI- 101501

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 10-16-01 Time: 1040 Method: SS BOWL/SPOON Monitor Reading (ppm):	0-0.5'	LT. GRAY	SANDY SILT - SATURATED TR CLAY

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

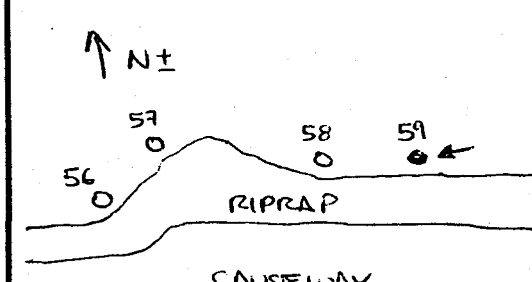
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL PAH's/SELECT METALS	1-4-OZ JAR/Cool 4°C		
SELECT PEST/ TCL PCB's	1-4-OZ JAR/Cool 4°C		
SELECT METALS/TCL PCB's	1-4-OZ JAR/Cool 4°C		
SELECT METALS/SELECT PEST	1-4-OZ JAR/Cool 4°C	✓	

OBSERVATIONS / NOTES:

9" WATER ±

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

SJ Conte

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: Parris Island-Site 3
Project No.: CTO-150---N3920

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: PAI-03-SD- 60-01
Sample Location: PAI-03-SD- 60
Sampled By: MW/JB
C.O.C. No.: PAI- 101501

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 10-16-01 Time: 1050 Method: SS BOWL/SPOON Monitor Reading (ppm):	0-0.5	BRN	SANDY SILT - SATURATED.

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

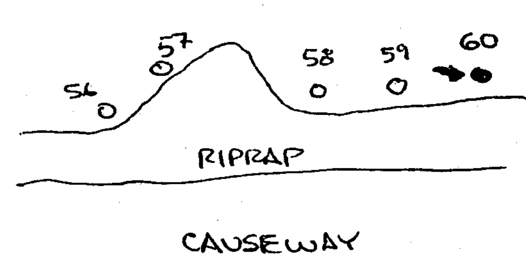
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL PAH's/SELECT METALS	1-4-OZ JAR/Cool 4°C		
SELECT PEST/ TCL PCB's	1-4-OZ JAR/Cool 4°C		
SELECT METALS/TCL PCB's	1-4-OZ JAR/Cool 4°C		
SELECT METALS/SELECT PEST	1-4-OZ JAR/Cool 4°C	✓	

OBSERVATIONS / NOTES:

1' DEEP (WATER)

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

SJ Conte

A-2 2003 FIELD INVESTIGATION

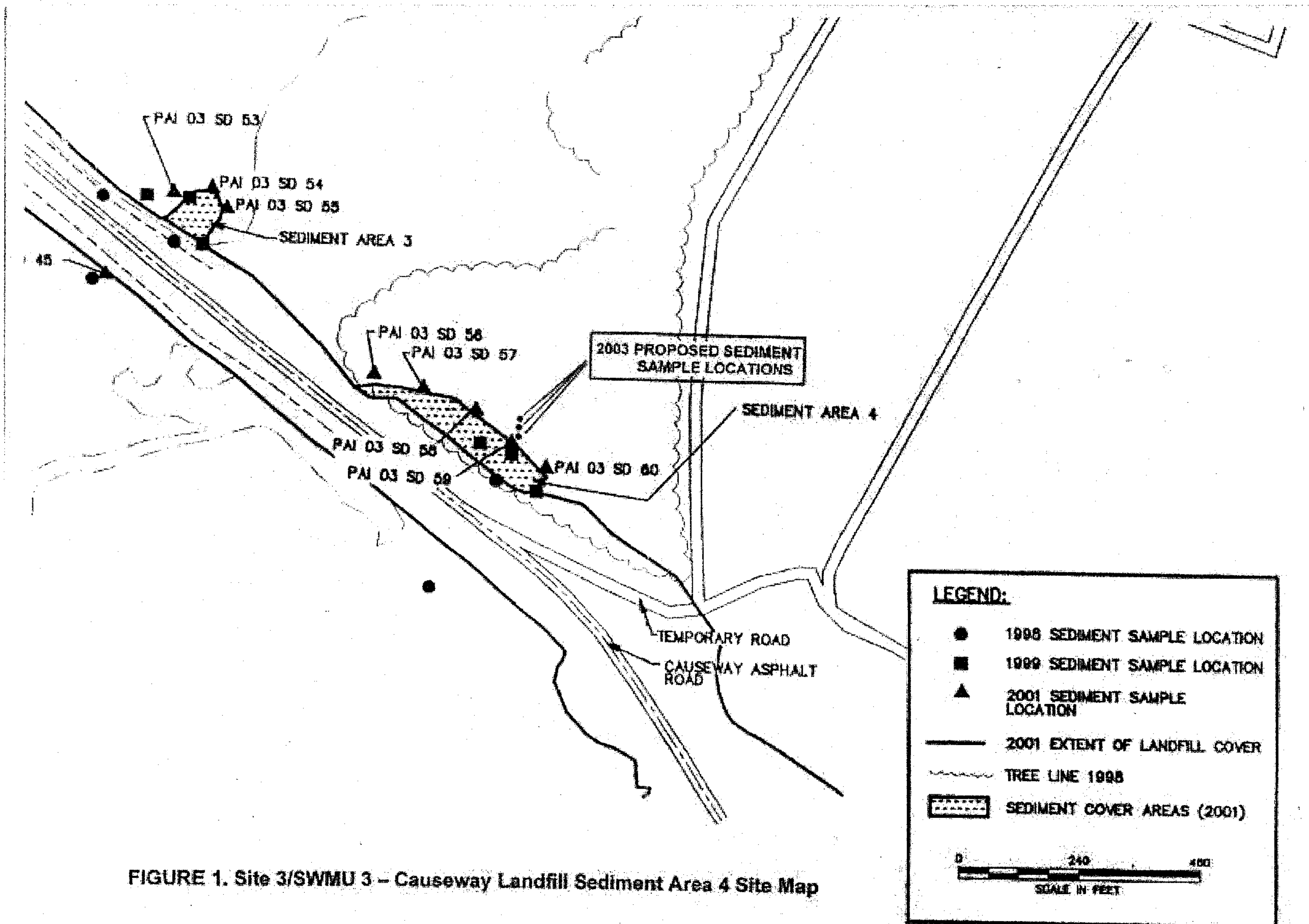


FIGURE 1. Site 3/SWMU 3 – Causeway Landfill Sediment Area 4 Site Map

Modified figure taken from Tetra Tech NUS, Inc., May 2002

Nardina faxed the laboratory information including addresses, etc., to the Hampton Inn about 0900 on Monday, April 14, 2003. I made a second call to Tim Harrington and left him another message stating that we have received the fax and are now mobing to MCRD to sample. Sam and I arrived at Site 3, Area 4 around 1000. After setting up we proceeded to take the scaled site sample drawing to locate original sample location SD-59 where our first sample will be co-located. We got lucky and found a sample pin flag marked SD-59 on a stake in the marsh about the location as marked on the scaled map (photo 001). Now the hard part, trying to determine where the next two samples will be located. We did find a small rivulet to the right, southeast of SD-59. From Priscilla's last email reply, this looks to be the one she saw. The second sample was located on the inside bend of the rivulet (Photo 008, 009 &0013). The third sample was located where two rivulets, one of which was the second sample location and the other rivulet is the one we photographed in February, merged together and widened, some 60 feet north of SD-59 (Photo 0017 & 0019). The sediment samples were collected with a small bottom dredge. The contents of the dredge were emptied into clean stainless steel bowls, then placed into the appropriate sample containers then placed on ice in the cooler (Photo 003). All equipment was then decontaminated according to plan (Photo 0020). Organic matter both dead and alive were encountered at each sample location and varied in thickness from 6-8-inches. Water depth ranged from 4-6-inches.

Sediment sampling at the OWWTP site went according to plan. The locations were more straightforward; the first sample was collected in the marsh just below the junction box. The second sample was collected along the broken discharge pipe halfway between the third sample and the first sample, approximately 80-ft. The third sample was located approximately 160 feet into the marsh from the first sample location, where the broken clay pipe visibly terminated (Photo 0025). The samples at the OWTTP site were collected in the same manner as was conducted at Area 4. However, all samples were collected above the tide line. Also, little to no organic matter was present at the OWWTP site. Tim Harrington showed up about the time we collected the third sample. We spent the rest of the afternoon with sample management. The samples were FedEx that evening to the three respective labs. I telephoned all labs contacts to let them know a shipment was coming.

A-3 2009 FIELD INVESTIGATION

ATTACHMENT C
CHAIN-OF-CUSTODY RECORD FORM

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER 3413 | PAGE 1 OF 1

PROJECT NO:	FACILITY:	PROJECT MANAGER	PHONE NUMBER	LABORATORY NAME AND CONTACT:
SAMPLERS (SIGNATURE) M J Whitt		FIELD OPERATIONS LEADER	PHONE NUMBER	ADDRESS
		CARRIER/WAYBILL NUMBER FedEx		CITY, STATE

STANDARD TAT ☐
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G)
PRESERVATIVE USED

DATE YEAR	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	TYPE OF ANALYSIS: Hg	cu	DDT, DDD, DDE	PCB congeners	lipid content	moisture content	HOLD for now		COMMENTS
10/26/09	1440	PAI-03-RD-02-01				Fish			✓	✓	✓	✓	✓	✓			
	1450	MU-02-02							✓	✓	✓	✓	✓	✓			
	1456	MU-02-03													✓		hold
	1510	RD-04-01							✓	✓	✓	✓	✓	✓			use as duplicate
	1515	RD-04-02							✓	✓	✓	✓	✓	✓			
	1522	MU-04-03							✓	✓	✓	✓	✓	✓			
	1526	MU-04-04							✓	✓	✓	✓	✓	✓			use as duplicate
	1530	MU-04-05													✓		hold
		RD-DUP-01							✓	✓	✓	✓	✓	✓			dup of RD-04-01
		MU-DUP-02							✓	✓	✓	✓	✓	✓			dup of MU-04-04

1. RELINQUISHED BY M J Whitt	DATE 10-26-09	TIME 1630	1. RECEIVED BY FedEx	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME
COMMENTS					

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

019611/P

ATTACHMENT C
CHAIN-OF-CUSTODY RECORD FORM

TETRA TECH NUS, INC. — CHAIN OF CUSTODY — NUMBER 3413 — PAGE 1 OF 1

PROJECT NO:	FACILITY:	PROJECT MANAGER: M. Slattic	PHONE NUMBER	LABORATORY NAME AND CONTACT:
SAMPLERS (SIGNATURE): MJ Whitten		FIELD OPERATIONS LEADER: M. Whitten	PHONE NUMBER: 803-507-6076	ADDRESS
		CARRIER/WAYBILL NUMBER		CITY, STATE

STANDARD TAT ☐
RUSH TAT ☐ ☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G)
PRESERVATIVE USED: ice, ice, ice, ice, ice

DATE YEAR 2009	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAP (G) COMP (C)	No. OF CONTAINERS	Mercury + copper	DDT, DDD, DDE	PCB congeners	lipid content	moisture content				COMMENTS
10/27	1520	PAI-03-MU-03-01				fish			✓	✓	✓	✓	✓				
10/27	1530	PAI-03-MU-03-02				↓			✓	✓	✓	✓	✓				
10/27	1540	PAI-03-RD-03-03				↓			✓	✓	✓	✓	✓				
10/27	1550	PAI-03-MU-01-01				↓			✓	✓	✓	✓	✓				

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY: MJ Whitten	10-27-09	1630	1. RECEIVED BY: FedEx		
2. RELINQUISHED BY			2. RECEIVED BY		
3. RELINQUISHED BY			3. RECEIVED BY		

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TINUS-001

TETRA TECH NUS, INC. | **CHAIN OF CUSTODY** | **NUMBER** 27316 | **PAGE** 1 **OF** 1

PROJECT NO:	FACILITY: Parris Island	PROJECT MANAGER	PHONE NUMBER	LABORATORY NAME AND CONTACT:
SAMPLERS (SIGNATURE) M J Whitten		FIELD OPERATIONS LEADER M. Whitten	PHONE NUMBER 803-507-6076	ADDRESS
		CARRIER/WAYBILL NUMBER		CITY, STATE

STANDARD TAT ☐
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G)
PRESERVATIVE USED: ice, ice, ice, ice, ice

DATE YEAR 2009	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	TYPE OF ANALYSIS: Mercury, Copper	DDT, DDD, DDE	PCB congeners	lipid content	moisture content				COMMENTS
10/28	1605	PAI-03-MU-02-04				Fish		1	✓	✓	✓	✓	✓				
10/28	1610	PAI-03-BD-02-05				↓		↓	✓	✓	✓	✓	✓				
10/28	1615	PAI-03-BD-02-06				↓		↓	✓	✓	✓	✓	✓				
10/28	1620	PAI-03-BD-02-07				↓		↓	✓	✓	✓	✓	✓				
10/28	1625	PAI-03-RD-03-04				↓		↓	✓	✓	✓	✓	✓				
10/28	1628	PAI-03-RD-01-02				↓		↓	✓	✓	✓	✓	✓				
10/28	1633	PAI-03-RD-01-03				↓		↓	✓	✓	✓	✓	✓				
10/28	1635	PAI-03-MU-01-04				↓		↓	✓	✓	✓	✓	✓				

One Chain of Custody (8 fish) for two coolers.
(The above 8 fish are being shipped in two coolers).
M. Whitten
10/28/09

1. RELINQUISHED BY M J Whitten	DATE 10/28/09	TIME 1745	1. RECEIVED BY	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

TETRA TECH NUS, INC. CHAIN OF COCUSTODY | NUMBER 27317 | PAGE ____ OF ______

PROJECT NO:	FACILITY: Parris Island	PROJECT MANAGER	PHONE NUMBER	LABORATORY NAME AND CONTACT:
SAMPLERS (SIGNATURE) M J Whitten		FIELD OPERATIONS LEADER M. Whitten	PHONE NUMBER 803-507-6076	ADDRESS
		CARRIER/WAYBILL NUMBER		CITY, STATE

STANDARD TAT ☐
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G)

PRESERVATIVE USED: ice, ice, ice, ice, ice

DATE YEAR 2009	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	Mercury, copper	DDT, DDD, DDE	PCB congenors	lipid content	moisture content				COMMENTS
10/29	1800	PAI-03-BD-RF-01				Fish		1	✓	✓	✓	✓	✓				
10/29	1810	PAI-03-MU-RF-02				↓		↓	✓	✓	✓	✓	✓				
10/29	1820	PAI-03-MU-RF-03				↓		↓	✓	✓	✓	✓	✓				
10/30	1620	PAI-03-MU-RF-04				↓		↓	✓	✓	✓	✓	✓				
10/30	1625	PAI-03-MU-RF-05				↓		↓	✓	✓	✓	✓	✓				
10/30	1630	PAI-03-RD-RF-06				↓		↓	✓	✓	✓	✓	✓				

The above 6 fish are being shipped in 2 coolers.

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY M J Whitten	10/30/09	1745	1. RECEIVED BY		
2. RELINQUISHED BY			2. RECEIVED BY		
3. RELINQUISHED BY			3. RECEIVED BY		

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER 27320 | PAGE 1 OF 1

PROJECT NO:	FACILITY: Davis Island	PROJECT MANAGER Mark Sladic	PHONE NUMBER	LABORATORY NAME AND CONTACT:
SAMPLERS (SIGNATURE) MJ Whitten		FIELD OPERATIONS LEADER Mike Whitten	PHONE NUMBER 803-641-6313	ADDRESS
		CARRIER/WAYBILL NUMBER		CITY, STATE

STANDARD TAT ☐
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G)

PRESERVATIVE USED: dry ice | dry ice | dry ice | dry ice | dry ice

DATE YEAR 2009	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	TYPE OF ANALYSIS: Mercury, copper	DDT, DDD, DDE	PCB congeners	Lipid content	Moisture content				COMMENTS
10/31	1530	PAI-03-RD-RF-07				fish			✓	✓	✓	✓	✓				
10/31	1530	PAI-03-RD-DUP-03				fish			✓	✓	✓	✓	✓				duplicate of RF-07
		Note: The above two samples are one single fish.															
10/31	1535	PAI-03-RD-RF-08				fish			✓	✓	✓	✓	✓				
10/31	1540	PAI-03-RD-RF-09				fish			✓	✓	✓	✓	✓				

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY MJ Whitten	11/2/09	1730	1. RECEIVED BY		
2. RELINQUISHED BY			2. RECEIVED BY		
3. RELINQUISHED BY			3. RECEIVED BY		

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

Fish Tissue Field Form
Site 3 – Causeway Landfill Fish Tissue Risk Assessment

Field Personnel	M. Whitten, P. Moore, D. Holtiwanger
Site	Causeway Landfill
Weather Tide Condition	overcast wind NE / 10-12 G15

Date	Time	Sample ID	Collection Method	Length (~~cm~~ mm)	Weight (g)	Species	Sex	Comment (gross morphological abnormalities, etc.)
10/26/09	1440	PAI -03- RD-02-01	GN	543	1353	RD	U	
	1450	PAI -03- MU-02-02		383	626	MU	U	
	1456	PAI -03- MU-02-03		216	104	MU	U	too small - hold at lab
	1510	PAI -03- RD-04-01		960		RD	U	> 13 lbs used as dup, removed head to fit in cooler
	1515	PAI -03- RD-04-02		322	309	RD	U	length less than slot size
	1522	PAI -03- MU-04-03		417	835	MU	U	
	1526	PAI -03- MU-04-04		520	1600	MU	U	used as dup
	1530	PAI -03- MU-04-05		416	777	MU	U	hold at lab (extra)
		PAI -03-						
		PAI -03-						
		PAI -03-						
		PAI -03-						
		PAI -03-						
		PAI -03-						

SPECIES: Red Drum = **RD**, Croaker = **CR,** Mullet = **MU**
SEX: Male = **M,** Female = **F,** Unknown = **U**
COLLECTION METHOD: gill nets = **GN,** cast net = **CA,** rod & reel = **RR**

Signature M J Whitten

Date 10/26/09

Target Organisms	
SPECIES	SIZE
Red Drum **(RD)**	15-23 in (38.1 - 58.4 cm)
Croaker **(CR)**	> 12 in (30.5 cm)
Mullet **(MU)**	> 12 in (30.5 cm)

Fish Tissue Field Form
Site 3 – Causeway Landfill Fish Tissue Risk Assessment

Field Personnel	M. Whitten, D. Haltiwanger, P. Moore
Site	Causeway Landfill
Weather, Tide Conditions	overcast wind E/5-10 morning Afternoon: heavy rain @ 1330-1400

Date	Time	Sample ID	Collection Method	Length (~~cm~~ mm)	Weight (g)	Species	Sex	Comment (gross morphological abnormalities, etc.)
10/27/09	1520	PAI -03- MU-03-01	GN	360	489	MU	U	
↓	1530	PAI -03- MU-03-02	GN	385	591	MU	U	
↓	1540	PAI -03- RD-03-03	GN	820	5800	RD	U	
↓	1550	PAI -03- MU-01-01	GN	~~8355~~ 339	370	MU	U	
		PAI -03-						
		PAI -03-						
		PAI -03-						
		PAI -03-						
		PAI -03-						
		PAI -03-						
		PAI -03-						
		PAI -03-						
		PAI -03-						
		PAI -03-						

SPECIES: Red Drum = **RD,** Croaker = **CR,** Mullet = **MU**
SEX: Male = **M,** Female = **F,** Unknown = **U**
COLLECTION METHOD: gill nets = **GN,** cast net = **CA,** rod & reel = **RR**

Signature MJ Whitten

Date 10/27/09

Target Organisms	
SPECIES	SIZE
Red Drum **(RD)**	15-23 in (38.1 - 58.4 cm)
Croaker **(CR)**	> 12 in (30.5 cm)
Mullet **(MU)**	> 12 in (30.5 cm)

Fish Tissue Field Form

Site 3 – Causeway Landfill Fish Tissue Risk Assessment

Field Personnel	M. Whitten, D. Haltiwanger, P. Moore
Site	Causeway Landfill Pond
Weather, Tide Conditions	0815: overcast, 70°F, wind SW/5

Date	Time	Sample ID	Collection Method	Length (~~cm~~ mm)	Weight (g)	Species	Sex	Comment (gross morphological abnormalities, etc.)
10/28/09	1605	PAI -03- MU - 02 - 04	GN	472	1180	MU	U	
	1610	PAI -03- BD - 02 - 05	GN	370	656	BD	U	
	1615	PAI -03- BD - 02 - 06	GN	397	868	BD	U	
	1620	PAI -03- BD - 02 - 07	GN	392	901	BD	U	
	1625	PAI -03- RD - 03 - 04	GN	925	7600	RD	U	
	1628	PAI -03- RD - 01 - 02	RR	488	1100	RD	U	
	1633	PAI -03- RD - 01 - 03	GN	338	382	RD	U	
	1635	PAI -03- MU - 01 - 04	GN	480	1050	MU	U	
		PAI -03-						
		PAI -03-						
		PAI -03-						
		PAI -03-						
		PAI -03-						
		PAI -03-						

SPECIES: Red Drum = **RD**, Croaker = **CR**, Mullet = **MU** , BD = black drum
SEX: Male = **M**, Female = **F**, Unknown = **U**
COLLECTION METHOD: gill nets = **GN**, cast net = **CA**, rod & reel = **RR**

Signature M J Whitten

Date 10/28/09

Target Organisms	
SPECIES	SIZE
Red Drum **(RD)**	15-23 in (38.1 - 58.4 cm)
Croaker **(CR)**	> 12 in (30.5 cm)
Mullet **(MU)**	> 12 in (30.5 cm)

Fish Tissue Field Form
Site 3 – Causeway Landfill Fish Tissue Risk Assessment

Field Personnel	M. Whitten, D. Haltiwanger
Site	Reference site (General's Landing creek)
Weather, Tide Conditions	Various - details in field notebook

Date	Time	Sample ID	Collection Method	Length (mm)	Weight (g)	Species	Sex	Comment (gross morphological abnormalities, etc.)
10/29/09	1800	PAI -03- BD-RF-01	GN	272	290	BD		
	1810	PAI -03- MU-RF-02		375	557	MU		
	1820	PAI -03- MU-RF-03		320	345	MU		
10/30/09	1620	PAI -03- MU-RF-04		489	1182	MU		
	1625	PAI -03- MU-RF-05		377	468	MU		
	1630	PAI -03- RD-RF-06		593	2050	RD		
10/31/09	1530	PAI -03- RD-RF-07		405	747	RD		
	1535	PAI -03- RD-RF-08		401	662	RD		
	1540	PAI -03- RD-RF-09		352	406	RD		
		PAI -03-						
		PAI -03-						
		PAI -03-						
		PAI -03-						
		PAI -03-						

SPECIES: Red Drum = **RD**, Croaker = **CR**, Mullet = **MU**, BD = black drum
SEX: Male = **M**, Female = **F**, Unknown = **U**
COLLECTION METHOD: gill nets = **GN**, cast net = **CA**, rod & reel = **RR**

Signature M L Whitten

Date 10-29-09 / 10/30/09 / 10-31-09

Target Organisms	
SPECIES	SIZE
Red Drum **(RD)**	15-23 in (38.1 - 58.4 cm)
Croaker **(CR)**	> 12 in (30.5 cm)
Mullet **(MU)**	> 12 in (30.5 cm)

Parris Island - Site 3 Fish Collection

26 OCT 09 M. Whitten

D. Haltiwanger, P. Moore

1030 ATA Causeway Park at NE ramp, Malecon Drive is closed this week

overcast, 64°, wind E/5-8

1210 first net out

1215 2nd net out

N32° 21.194'
W 080° 41.838' south end of 2nd net

N32° 21.151' W 080° 41.875'
3rd net - south end

N32° 21.139' W 080° 41.926'
4th net south end

1246 - Kept 4 mullet from 4th net set out

(threw back 2 mullet + 1 pinfish

1

Time: 1240 (10/26/09)

pH 7.26

cond 20.8 ~~MTOs~~

turb 5.45

DO ~~20.115~~ 5.41

Temp 20.11

Sal 4.0% (flashing)

ORP 0.111 (111?)

at 4th net while pulling in net

Time 1330

pH 7.81
cond 83.4 Ms/cm
turb 15.7
DO 5.19
temp 20.11
sal 4.0 blinking
ORP 101

1620 at Post office awaiting FedEx
1655 ATD MCRD

M. Whitten
P. Moore
D. Haltiwanger

(10/27/09)

MCRD
Parris Island

0810: boat in water Quad # 1

N 32° 21.502' } NW end of 1st net
0820 W 080° 42.268'

wind ~~S~~E 5-10 temp 65°
overcast

0830 2nd net at Quad #1

N 32° 21.489' } mid point of 2nd net
W 080° 42.293'

0840 3rd net mid point
N 32° 21.385'
W 080° 42.327'

0850 4th net going in water
mid point of 4th net
N 32° 21.347'
W 080° 42.259'

all 4 nets oriented E-W

10/27/09

MSW net set up correctly
time 1040

pH	7.08	7.52
cond.		99.9 blinking
turbidity	60.4	17.2
D.O.	9.	6.59
temp	18.68°C	19.1
salinity		4.0 flashing

10:15 caught 2 red drum - Quad 3
kept one & released one (~33-36")

10:40 overcast, wind E/5-10, temp 68°

Kent ~~Kre~~ Krieg
Susan Byrd
cell 803-603-4237
} DHEC visitors 1105

1:30 checking net in Quad # 1
1 mullet & many pinfish
heavy rain
2:00 stopped & returned to boat ramp
due to heavy rain.

10/27/09

2:30 Rain stopped; drained boat & back in water to pull in all 4 gill nets

3:30 back at boat ramp. Total fish
Kept today: $\boxed{1 \text{ Red drum} + 3 \text{ mullet}}$
Many (≈50?) pinfish & shad & Atlantic menhaden in nets - 2 mullet in nets escaped; 1 large flounder, 1 juvenile black drum, 1 ladyfish

4:30 hand delivered cooler w/ 4 fish to FedEx at post office (MCRD).

5:20 ATA hotel

10/28/09

M. Whitten, D. Haltiwanger, P. Moore

0815 boat in water @ NE ramp
overcast, 70°, wind SW/5

0820 first net out SW - NE Quad 1
0828 2nd net out SW - NE " "
midpoint N 32° 21.479'
W 080° 42.246'
0835 3rd net out Quad 3
midpoint N ~~0~~ 32° 21.424'
W 080° 42.292'
0840 4th net out — Quad 3
mid point N 32° 21.329
W 080° 42.242

pH 7.52
cond 99.9 blinking
turb 0.0 blinking
DO 7.45
temp 21.13
sal 4.0 blinking

10/28/09

0905 5th net out - in Quad 2
midpt N 32° 21.371'
W 080° 41.903'

0910 6th net out - Quad 2
mid pt N 32° 21.343'
W 080° 41.928'

0915 7th net Quad 2
midpt N 32° 21.301'
W 080° 41.837'

0945 pH 11.9 too high
cond 14.1
turb 0.0 blinking
DO blinking
temp 21.31 °C
sal 0.76 % too low

1415 - began pulling in nets
collected for shipment:
Quad 2: 3 black drum, 1 mullet
Quad 3: 1 red drum
Quad 1: 2 red drum, 1 mullet

 (over)

10/28/09

1500 one red drum from Quad 1
was caught by hook + line by
Kent Krieg (SDHEC) who
visited the site today.
All other fish so far have been
collected by gill net

1715 - ATD MCRD - headed
to FedEx pickup in Port Royal
1800 - FedEx pickup
1820 - ATA hotel

misc.
Fish caught but not kept today:
pinfish, shad, 2 flounder,
sheepshead, spot

10/29/09

M. Whitten
D. Holtiwanger

0805 ATA boat ramp at General's
Landing Creek (Background/Ref Site)
0910 finished setting 7 nets
between mouth of creek & boat landing
0915 temp 69°, wind light/var
sky 0.5 scattered

1430 pulled in one net - 5 sharks
in net.
1515 set 2 nets upstream, near
golf course ∴ 8 nets out
1630 began pulling 6 nets by
mouth of creek - numerous
sharks, trout, whiting, spot, pinfish,
a few flounder, 1 ray, Atlantic menhaden
Kept 2 mullet > 12 inches
2 mullet < 12 inches (discarded on 10/30)
1 black drum
left (for overnight) 2 nets near
golf course

1930 ATA hotel

Tides today

high	0542	7.0
low	1153	1.4
high	1812	7.0

Horiba inop.

10/30/09

M. Whitten
D. Holtiwanger

0830 first net put out } vcty of
0845 3rd net put out } boat ramp
0845 overcast; SSE 5-10 General's
temp 67° Landing Creek

1015 back at boat ramp after
setting 7 nets this morning
one net checked that was left
overnight - no keepers - only
3 sheepshead + various small fish
one net not found yet (left overnight)

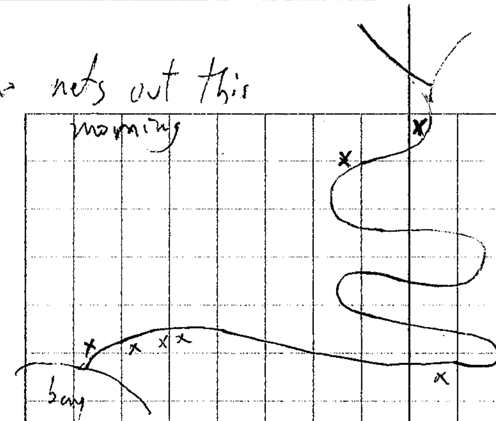
1115 spoke w/ Debbie Nadeau @ Katahdin
① for saturday delivery, send FedEx to
Katahdin Analytical Services
95 Hutchins Drive
Portland, ME 04102
Hold For Pickup
② call Katahdin w/ tracking # + # coolers

1245 low tide - found "missing"
net from last night

1300 overcast, wind SE 5-10 G 15; 72°

10/30/09

x- nets out this morning



Tides today

low	0018	0.9
high	0631	7.4
low	1244	1.1
high	1858	7.1

1430 began checking nets
1630 kept 2 large mullet and 1 red drum
threw back numerous (~100) small
fish of various species; spot, pinfish,
a few croaker, bonnethead shark,
flounder, sting rays, blue crab, shad,
stone crab, spotted seatrout.
Left out for overnight - 4 nets

1715 At A FedEx drop off pt, Port Royal
w/ 6 fish (3 today + 3 yesterday)
for delivery
Yesterday-caught fish are frozen w/ dry
ice, the 3 today are on wet ice.

One cooler (I bought yesterday) should
be returned to us by Katahdin -
→ Tell them so!

10/30/09

1745 - FedEx pickup arrive
1803 ATA hotel

10/31/09 M. Whitten
D. Haltiwanger

0800 in water at ramp - General's Landing Creek
heavy fog, 68°, no wind

0810 checked first net from last night - no keepers
re-set net
0915 set one net at mouth of creek fork immed. south of sandy circular area that we drove to last May
0930 set 2 nets downstream of major fork
∴ have set 4 nets today so far

2 nets from last night missing as of now!

high tide at ~ 0730

10/31/09 (continued)

0955 set out another net (∴ 5 so far)
this one is on west side of creek immed. upstream of fork

1030 most low fog gone
sky 0.5 (low fog-like clouds)
wind calm (< 2 MPH) temp 73°

1215 clear sky, wind S/5, Temp 78°

We have recovered the two "missing" nets from last night - No keepers
threw back stone crab, croakers, pinfish, shad, whiting (Sou. kingfish), spotted trout (+ many oyster shells).

1400 began pulling in all 5 nets
1515 - finished w/ nets
caught 3 red drum ∴ have 4 total

1545 leaving boat ramp RTB (home!)

TETRA TECH

December 14, 2009

Ms. Barbary Hasty
South Carolina DNR
Wildlife and Freshwater Fisheries
P.O. Box 167
Columbia, SC 29202

Reference: Permit No. F-09-46

Subject: Activity Report on Fish Sampling, Parris Island MCRD

Dear Ms. Hasty:

I have attached a table that lists all fish collected in 2009, by sampling location. All fish were sacrificed.

Should you have any questions concerning this transmittal, please contact me directly at (803) 641-6311.

Sincerely,

Phil Moore

Philip R. Moore
Consulting Fisheries Scientist

cc w/attachment.: M. L. Whitten, TtNUS
M. Sladic, TtNUS

Tetra Tech NUS, Inc.
900 Trail Ridge Road, Aiken, SC 29803
Tel: 803.649.7963 Fax: 803.642-8454 www.tetratech.com

Table 1. Fish Collected October 26-31, 2009, at MCRD Parris Island and Retained for Laboratory Analysis of Selected Chemicals.

Location	Sample ID	Species	Length (cm)	Weight (g)
3rd Battalion Pond Quadrant 1	PAI-03-MU-01-01	Mullet	33.9	370
	PAI-03-RD-01-02	Red drum	48.8	1100
	PAI-03-RD-01-03	Red drum	33.8	382
	PAI-03-MU-01-04	Mullet	48.0	1050
3rd Battalion Pond Quadrant 2	PAI-03-RD-02-01	Red drum	54.3	1353
	PAI-03-MU-02-02	Mullet	38.3	626
	PAI-03-MU-02-04	Mullet	47.2	1180
	PAI-03-BD-02-05	Black drum	37.0	656
	PAI-03-BD-02-06	Black drum	39.7	868
	PAI-03-BD-02-07	Black drum	39.2	901
3rd Battalion Pond Quadrant 3	PAI-03-MU-03-01	Mullet	36.0	489
	PAI-03-MU-03-02	Mullet	38.5	591
	PAI-03-RD-03-03	Red drum	82.0	5800
	PAI-03-RD-03-04	Red drum	92.5	7600
3rd Battalion Pond Quadrant 4	PAI-03-RD-04-01	Red drum	96.0	9100(1)
	PAI-03-RD-04-02	Red drum	32.2	309
	PAI-03-MU-04-03	Mullet	41.7	835
	PAI-03-MU-04-04	Mullet	52.0	1600
Reference Site	PAI-03-BD-RF-01	Black drum	27.2	290
	PAI-03-MU-RF-02	Mullet	37.5	557
	PAI-03-MU-RF-03	Mullet	32.0	345
	PAI-03-MU-RF-04	Mullet	48.9	1182
	PAI-03-MU-RF-05	Mullet	37.7	468
	PAI-03-RD-RF-06	Red drum	59.3	2050
	PAI-03-RD-RF-07	Red drum	40.5	747
	PAI-03-RD-RF-08	Red drum	40.1	662
	PAI-03-RD-RF-09	Red drum	35.2	406

(1) The weight of this sample exceeded the maximum quantity of the available scales (13 pounds [5900 g]). Based on length-to-weight data provided by Wenner (1992), the estimated weight of this fish was approximately 20 pounds (9100 g).

APPENDIX B

INTERVIEW WITH CIVILIAN RECREATIONAL USER

-----Original Message-----
From: Harrington CIV Timothy J [mailto:timothy.j.harrington@usmc.mil]
Sent: Friday, January 30, 2009 11:25 AM
To: Sladic, Mark
Subject: RE: EPA APPROVES Re: FINAL QUESTIONS FOR FISHING ON SITE 3 POND

Two boys about 8 and 10.

-----Original Message-----
From: Sladic, Mark [mailto:Mark.Sladic@tetratech.com]
Sent: Friday, January 30, 2009 11:09
To: Harrington CIV Timothy J
Subject: RE: EPA APPROVES Re: FINAL QUESTIONS FOR FISHING ON SITE 3 POND

Hi Tim. Sorry to pester. If this information (below) is available, this might be an important/useful data point for our conference call on Tuesday.
Thanks. MS

-----Original Message-----
From: Sladic, Mark
Sent: Thursday, January 22, 2009 3:17 PM

Hi Tim. Do you know if the woman that fishes at the 3rd Battalion Pond has any children of her own, particularly in the 4-6 years bracket (or younger)? Thanks. MS

-----Original Message-----
From: Harrington CIV Timothy J [mailto:timothy.j.harrington@usmc.mil]
Sent: Monday, December 01, 2008 7:45 AM
To: Sladic, Mark
Cc: Cook, Charles CIV NAVFAC SE; Zimmerman, Greg; Pittman CIV Darrel H
Subject: RE: EPA APPROVES Re: FINAL QUESTIONS FOR FISHING ON SITE 3 POND

Mark,

My gut reaction is that 350 is probably pretty close, maybe 500. For example, in discussing shrimp, yes she prepares one half to a one pound of shrimp at a time, but she eats shrimp like the average American might eat chips. She will consume those shrimp throughout the course of the day. So,
maybe that size portion accounts for more than one meal. I think the issue
is the combination of the number and sizes of meals, i.e., if larger portions then fewer meals.

She is a tiny lady. I don't see her sitting down three times a day to eat large quantities of food

V/R, Tim

-----Original Message-----
From: Sladic, Mark [mailto:Mark.Sladic@tetratech.com]
Sent: Friday, November 21, 2008 12:31
To: Harrington CIV Timothy J
Cc: Cook, Charles CIV NAVFAC SE; Zimmerman, Greg; Pittman CIV Darrel H
Subject: RE: EPA APPROVES Re: FINAL QUESTIONS FOR FISHING ON SITE 3 POND

Hi Tim: We used the information from the civilian angler interview (below) to
develop inputs to the risk assessment for fish consumption from the Site 3 pond (attached). Generally, the Team buys into how we translated the interview into numerical values. However, we did get some pushback on one input.

For Exposure Frequency, we interpreted from the interview results that 350 meals per year from the Site 3 Pond was reasonable. This considers the following:
(1) Civilian angler reports eating fish daily from the pond.
(2) Civilian angler reports that most of what she is consuming comes from 3rd Bn Pond.
(3) Currently, only visits pond on weekends.
(4) Civilian angler reports that most every meal comes from 3rd Bn pond, unless
husband cooks.
(5) Also eats 1/2 to 1 pound of shrimp per meal.
(6) Provides list of other fishing locations.

Based on this, we assumed the following:
(a) 350 fishing days per year
(b) one meal each day from 3rd Bn Pond (since she lists other locations, and
also eats shellfish, shrimp, husband cooks sometimes, etc.).

Based on your actual first-hand experience, do you think 350 meals/year is reasonable? Or does it understate what is likely consumed? Has her weekend-only ability to visit the pond impacted the amount of fish she can consume per week? Does her husband cook often? Is the pond fished-out yet?

Bottom line: EPA thinks that 350 meals per year might be too slight. We don't automatically want to make this 700 or 1100 (literally 3 meals/day, 365 days). What's your gut feeling how to interpret the lady's statements to arrive at meals per day (or per year)?
We can sort through it on the phone, if more convenient for you. Let us know.
Thanks.

Mark Sladic, P.E.
Project Manager
TETRA TECH NUS, Inc.
Telephone: (412) 921-8216
mark.sladic@tetratech.com

-----Original Message-----
From: Harrington CIV Timothy J [mailto:timothy.j.harrington@usmc.mil]
Sent: Friday, October 10, 2008 11:31 AM
To: Koroma-Llamas.Lila@epamail.epa.gov; Meredith Amick; Sommer Barker; Cook, Charles CIV NAVFAC SE; Pittman CIV Darrel H; diane_duncan@fws.gov; mmcrae@techlawinc.com; Sladic, Mark; Tom Dillon; wendtp@dnr.sc.gov
Subject: RE: EPA APPROVES Re: FINAL QUESTIONS FOR FISHING ON SITE 3 POND

Lila, et al,

We spoke to the woman who fishes at the Causeway Pond. Some editorializing here on the front end: Basically, she consumes fish daily from the pond. Even though she fishes at many other locations, on and off-base, she was fairly adamant that most of what she is consuming comes from 3rd Bn pond. Some of that may have been some communication obstacles, but I think for our purposes, we need to make the conservative assumption.

FISHING HABITS:

9 - On average, how often do you visit the Causeway Pond at Site 3 for any type of catch (fish, shrimp, crab, etc.)?
Daily until about 4 months ago, now only on the weekends. (she now works for a contractor on base)

7 - Do your fishing and eating habits vary seasonally? i.e., shrimp in the fall, crabs in spring, finfish during summer, flounder in summer, redfish during winter, etc. No, primarily I catch and consume finfish and shrimp. The type of fish varies by season

4 - What type of these fish OR SHELLFISH DO YOU CATCH FROM THE CAUSEWAY POND TO EAT? Flounder, spots, redfish, shrimp, squid, crabs (stone and blue), pin fish, mullet, sheep head, black drum and croakers,

FISH / SHELLFISH CONSUMPTION:

1 - How MANY OF YOUR INDIVIDUAL meals per week consist of fish OR SHELLFISH that were caught at THE CAUSEWAY POND?
Almost all of them, unless my husband cooks.
2a - What is the AVERAGE size of the fish meals? (FOR EXAMPLE, A SERVING OF FISH IS THE SIZE OF YOUR WHOLE HAND? OR IS IT THE SIZE OF JUST THE PALM OF YOUR HAND?) About the size of my hand. (Editor's comment: probably means about a 6 oz. Fillet.)

8 - Do you eat exclusively fillets? Do you consume any other parts of the fish? Fillets.

2b - WHAT IS THE NUMBER AND SIZE OF SHRIMP, CRAB, ETC.EATEN PER MEAL? One half to a pound of shrimp per meal.

6b - How much of your catch do you freeze? How much of the fish and shellfish in your freezer come from 3 rd Bn Pond (½, ¾, 7/8, most)? About a quarter of the catch is frozen. I have fish in my freezer that I caught last year.

5 - How long have YOU been EATING fish OR SHELLFISH CAUGHT FROM THE CAUSEWAY POND and how long do YOU expect to continue to EAT fish OR SHELL FISH CAUGHT FROM THE CAUSEWAY POND? I have been in Beaufort for about 6 years. I will continue to fish in the pond as long as I am here. I have no plans to move.

FISHING COMMUNITY:

3 - How many people DO YOU KNOW WHO eat fish OR SHELLFISH caught at THE CAUSEWAY POND? There are about 25 folks that we recognize as regulars. Although, they do not all fish all of the time.

10 - Does any one who is pregnant eat the catch? No. Most of Tess's compatriots are beyond childbearing age.

11 - Do children eat the catch? Yes.

ALTERNATIVE FISHING LOCATIONS:

6a - Where else do you fish? Do you catch the same types of fish and shellfish at other locations?
Broad River pier, Hole #13 at the golf course, Elliott's Beach, NIS Pier.
Yes

-----Original Message-----
From: Koroma-Llamas.Lila@epamail.epa.gov [mailto:Koroma-Llamas.Lila@epamail.epa.gov]
Sent: Thursday, September 25, 2008 10:36
To: Koroma-Llamas.Lila@epamail.epa.gov; Harrington CIV Timothy J; Meredith Amick; Sommer Barker; Cook, Charles CIV NAVFAC SE; Pittman CIV Darrel H; diane_duncan@fws.gov; mmcrae@techlawinc.com; SladicM@ttnus.com; Tom Dillon; wendtp@dnr.sc.gov
Subject: EPA APPROVES Re: FINAL QUESTIONS FOR FISHING ON SITE 3 POND
Importance: High

I heard from Tim Frederick, and he said these questions as-is are good to go. So as far as EPA is concerned, you are free to go interview : -)

Thanks,
Lila

-----Lila Koroma-Llamas/R4/USEPA/US wrote: -----

To: "Harrington CIV Timothy J" <timothy.j.harrington@usmc.mil>
From: Lila Koroma-Llamas/R4/USEPA/US

Date: 09/24/2008 03:14PM
cc: "Meredith Amick" <AmickMS@dhec.sc.gov>, "Sommer Barker" <BarkerJS@dhec.sc.gov>, "Cook, Charles CIV NAVFAC SE" <charles.cook2@navy.mil>, "Pittman CIV Darrel H" <darrel.pittman@usmc.mil>, diane_duncan@fws.gov, mmcrae@techlawinc.com, SladicM@ttnus.com, "Tom Dillon" <tom.dillon@noaa.gov>, wendtp@dnr.sc.gov, Lila Koroma-Llamas/R4/USEPA/US@EPA
Subject: Re: FINAL QUESTIONS FOR FISHING ON SITE 3 POND

Obviously these need to be retyped, but..... Just thought you might want these in a different order, and added a question or two which may be needed or not, but it doesn't hurt to ask instead of needing to go back. ALSO, keep in mind that you may need to ask additional questions while you are out there, based on what the answers are. Tim, I am sure you know the ultimate goal of figuring out how much catch from Site 3 is consumed over a period of time, and what that catch is, but Ken may not understand the fine nuances of the questions and answers. So if he is to ask the questions, you will need to step in with clarifying questions as need be.

I have not heard from Tim Frederick yet, our EPA HH Risk Assessor. I will forward this to him for review as well and hope to hear from him soon.

FISHING HABITS:

9 - On average, how often do you visit the Causeway Pond at Site 3 for any type of catch (fish, shrimp, crab, etc.)?

7 - Do your fishing and eating habits vary seasonally? i.e., shrimp in the fall, crabs in spring, finfish during summer, flounder in summer, redfish during winter, etc.

4 - What type of these fish OR SHELLFISH DO YOU CATCH FROM THE CAUSEWAY POND TO EAT?

FISH / SHELLFISH CONSUMPTION:

1 - How MANY OF YOUR INDIVIDUAL meals per week consist of fish OR SHELLFISH that were caught at THE CAUSEWAY POND?

2a - What is the AVERAGE size of the fish meals? (FOR EXAMPLE, A SERVING OF FISH IS THE SIZE OF YOUR WHOLE HAND? OR IS IT THE SIZE OF JUST THE PALM OF YOUR HAND?)

8 - Do you eat exclusively fillets? Do you consume any other parts of the fish?

2b - WHAT IS THE NUMBER AND SIZE OF SHRIMP, CRAB, ETC.EATEN PER MEAL?

6b - How much of your catch do you freeze? How much of the fish and shellfish in your freezer come from 3 rd Bn Pond (½, ¾, 7/8, most)?

5 - How long have YOU been EATING fish OR SHELLFISH CAUGHT FROM THE CAUSEWAY POND and how long do YOU expect to continue to EAT fish OR SHELL FISH CAUGHT FROM THE CAUSEWAY POND?

FISHING COMMUNITY:

3 - How many people DO YOU KNOW WHO eat fish OR SHELLFISH caught at THE CAUSEWAY POND?

10 - Does any one who is pregnant eat the catch?

11 - Do children eat the catch?

ALTERNATIVE FISHING LOCATIONS:

6a - Where else do you fish? Do you catch the same types of fish and shellfish at other locations?

APPENDIX C

ANALYTICAL DATABASE

C-1 2001 SEDIMENT SAMPLES

C-2 2003 SEDIMENT SAMPLES

C-3 2009 FISH TISSUE SAMPLES

C-1 2001 SEDIMENT SAMPLES

SEDIMENT - ANALYTICAL DATABASE
SITE/SWMU 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

SAMPLE NUMBER LOCATION COLLECTION DATE:	PAI-03-SD-41-01 PAI-03-SD-41 10/16/01	PAI-03-SD-41-01-AVG PAI-03-SD-41 10/16/01	PAI-03-SD-41-01-D PAI-03-SD-41 10/16/01	PAI-03-SD-42-01 PAI-03-SD-42 10/16/01	PAI-03-SD-43-01 PAI-03-SD-43 10/16/01	PAI-03-SD-44-01 PAI-03-SD-44 10/16/01	PAI-03-SD-45-01 PAI-03-SD-45 10/16/01	PAI-03-SD-45-01-AVG PAI-03-SD-45 10/16/01
Semivolatile Organics (ug/kg)								
1-METHYLNAPHTHALENE	28 U	28 U	28 U	26 U	70 UJ	56 U	42 UJ	42 UJ
2-METHYLNAPHTHALENE	28 U	28 U	28 U	26 U	70 UJ	56 U	42 UJ	42 UJ
ACENAPHTHENE	28 U	28 J	28 J	26 U	70 UJ	56 U	42 UJ	42 UJ
ACENAPHTHYLENE	28 U	28 U	28 U	26 U	70 UJ	56 U	42 UJ	42 UJ
ANTHRACENE	28 UJ	46 J	78 J	26 U	70 UJ	56 U	42 UJ	14 J
BENZO(A)ANTHRACENE	24 J	162 J	300 J	66	29 J	12 J	30 J	48.5 J
BENZO(A)PYRENE	11 J	90.5 J	170 J	48	70 UJ	56 U	14 J	22 J
BENZO(B)FLUORANTHENE	19 J	124.5 J	230 J	59	25 J	13 J	25 J	35 J
BENZO(G,H,I)PERYLENE	28 UJ	42.5 J	71 J	30	70 UJ	56 U	12 J	12 J
BENZO(K)FLUORANTHENE	7 J	44.5 J	82 J	24 J	70 UJ	56 U	42 UJ	14 J
CHRYSENE	12 J	101 J	190 J	34	70 UJ	56 U	17 J	24 J
DIBENZO(A,H)ANTHRACENE	28 U	26 J	26 J	12 J	70 UJ	56 U	42 UJ	42 UJ
FLUORANTHENE	42 J	256 J	470 J	91	34 J	21 J	58 J	89 J
FLUORENE	28 U	25.5	37	26 U	70 UJ	56 U	42 UJ	8 J
INDENO(1,2,3-CD)PYRENE	28 UJ	67 J	120 J	46	70 UJ	56 U	42 UJ	18 J
NAPHTHALENE	28 U	28 U	28 U	26 U	70 UJ	56 U	42 UJ	42 UJ
PHENANTHRENE	7 J	163.5 J	320 J	23 J	70 UJ	56 U	23 J	54.5 J
PYRENE	22 J	176 J	330 J	53	21 J	12 J	33 J	45 J
Pesticides/PCBs (ug/kg)								
4,4'-DDD	3.8 J	3.3 J	2.8 J	1.4 J	12 UJ	9.2 U	7.1 U	7.05 U
4,4'-DDE	1.8 J	1.6 J	1.4 J	1.5 J	2.9 J	1.7 J	1.6 J	1.65 J
4,4'-DDT	12 J	6.55 J	1.1 J	1.5 J	12 UJ	9.2 U	7.1 U	7.05 U
ALPHA-CHLORDANE	2.4 U	2.4 U	2.4 U	6.6	6.0 UJ	4.7 U	3.6 U	3.6 U
AROCLOR-1016	24 U	24 U	24 U	22 U	60 UJ	47 U	36 U	36 U
AROCLOR-1221	24 U	24 U	24 U	22 U	60 UJ	47 U	36 U	36 U
AROCLOR-1232	24 U	24 U	24 U	22 U	60 UJ	47 U	36 U	36 U
AROCLOR-1242	24 U	24 U	24 U	22 U	60 UJ	47 U	36 U	36 U
AROCLOR-1248	24 U	24 U	24 U	22 U	60 UJ	47 U	36 U	36 U
AROCLOR-1254	24 U	24 U	24 U	22 U	60 UJ	47 U	36 U	36 U
AROCLOR-1260	24 U	24 U	24 U	22 U	60 UJ	47 U	36 U	36 U
GAMMA-CHLORDANE	2.4 U	2.4 U	2.4 U	2.2 U	6.0 UJ	4.7 U	3.6 U	3.6 U
Inorganics (mg/kg)								
ARSENIC	2	1.9	1.8	2.2	9.5 J	13.6	3.8	4.2
COPPER	4.5	4	3.5	5	19.7 J	27.1	9.9	10.55
LEAD	7	6.15	5.3	13.2	19.0 J	27.3	12.6	13.4
MERCURY	0.01	0.01	0.01	0.04	0.06 J	0.06	0.05	0.05
ZINC	12.7	11.2	9.7	20.3	50.3 J	67.7	32.0 J	49.8 J
Miscellaneous Parameters (%)								
TOTAL SOLIDS	69.9	70.65	71.4	76	28.3	35.8	46.6	46.7

SEDIMENT - ANALYTICAL DATABASE
SITE/SWMU 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

SAMPLE NUMBER LOCATION COLLECTION DATE:	PAI-03-SD-45-01-D PAI-03-SD-45 10/16/01	PAI-03-SD-46-01 PAI-03-SD-46 10/16/01	PAI-03-SD-47-01 PAI-03-SD-47 10/16/01	PAI-03-SD-48-01 PAI-03-SD-48 10/16/01	PAI-03-SD-49-01 PAI-03-SD-49 10/16/01	PAI-03-SD-50-01 PAI-03-SD-50 10/15/01	PAI-03-SD-51-01 PAI-03-SD-51 10/15/01	PAI-03-SD-52-01 PAI-03-SD-52 10/15/01	PAI-03-SD-53-01 PAI-03-SD-53 10/15/01
Semivolatile Organics (ug/kg)									
1-METHYLNAPHTHALENE	42 U	28 U	50 U	34 U	28 U				
2-METHYLNAPHTHALENE	42 U	28 U	50 U	34 U	28 U				
ACENAPHTHENE	42 U	28 U	50 U	34 U	28 U				
ACENAPHTHYLENE	42 U	28 U	50 U	34 U	28 U				
ANTHRACENE	14 J	28 U	50 U	34 U	28 U				
BENZO(A)ANTHRACENE	67	28 U	18 J	13 J	13 J				
BENZO(A)PYRENE	30 J	28 U	50 U	34 U	28 U				
BENZO(B)FLUORANTHENE	45	28 U	15 J	10 J	10 J				
BENZO(G,H,I)PERYLENE	42 U	28 U	50 U	34 U	28 U				
BENZO(K)FLUORANTHENE	14 J	28 U	50 U	34 U	28 U				
CHRYSENE	31 J	28 U	11 J	9 J	6 J				
DIBENZO(A,H)ANTHRACENE	42 U	28 U	50 U	34 U	28 U				
FLUORANTHENE	120	28 U	25 J	28 J	27 J				
FLUORENE	8 J	28 U	50 U	34 U	28 U				
INDENO(1,2,3-CD)PYRENE	18 J	28 U	50 U	34 U	28 U				
NAPHTHALENE	42 U	28 U	50 U	34 U	28 U				
PHENANTHRENE	86	28 U	50 U	10 J	12 J				
PYRENE	57	28 U	17 J	17 J	14 J				
Pesticides/PCBs (ug/kg)									
4,4'-DDD	7.0 U								5.7 U
4,4'-DDE	1.7 J								5.7 U
4,4'-DDT	7.0 U								5.7 U
ALPHA-CHLORDANE	3.6 U								2.9 U
AROCLOR-1016	36 U					47 U	33 U	44 U	
AROCLOR-1221	36 U					47 U	33 U	44 U	
AROCLOR-1232	36 U					47 U	33 U	44 U	
AROCLOR-1242	36 U					47 U	33 U	44 U	
AROCLOR-1248	36 U					47 U	33 U	44 U	
AROCLOR-1254	36 U					47 U	33 U	44 U	
AROCLOR-1260	36 U					47 U	33 U	44 U	
GAMMA-CHLORDANE	3.6 U								2.9 U
Inorganics (mg/kg)									
ARSENIC	4.6	0.84	7.7	3.5	1	10.5	5.2	9.3	2.1
COPPER	11.2	1.9	10.2	6.2	1.1	22.5	7.7	13.8	3.2
LEAD	14.2	4.7	17.7	11.2	4.2	35.8	13.3	26.8	9.9
MERCURY	0.05	0.05	0.08	0.2	0.04	0.12	0.07	0.13	0.09
ZINC	67.6 J	7.3	36.1	28.6	6.7	72.5	25.4	48.4	16.5
Miscellaneous Parameters (%)									
TOTAL SOLIDS	46.8	71.2	40	57.3	71.3	35.8	51.2	38.9	58.2

SEDIMENT - ANALYTICAL DATABASE
SITE/SWMU 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

SAMPLE NUMBER LOCATION COLLECTION DATE:	PAI-03-SD-54-01 PAI-03-SD-54 10/15/01	PAI-03-SD-55-01 PAI-03-SD-55 10/15/01	PAI-03-SD-56-01 PAI-03-SD-56 10/16/01	PAI-03-SD-57-01 PAI-03-SD-57 10/16/01	PAI-03-SD-58-01 PAI-03-SD-58 10/16/01	PAI-03-SD-59-01 PAI-03-SD-59 10/16/01	PAI-03-SD-60-01 PAI-03-SD-60 10/16/01
Semivolatile Organics (ug/kg)							
1-METHYLNAPHTHALENE							
2-METHYLNAPHTHALENE							
ACENAPHTHENE							
ACENAPHTHYLENE							
ANTHRACENE							
BENZO(A)ANTHRACENE							
BENZO(A)PYRENE							
BENZO(B)FLUORANTHENE							
BENZO(G,H,I)PERYLENE							
BENZO(K)FLUORANTHENE							
CHRYSENE							
DIBENZO(A,H)ANTHRACENE							
FLUORANTHENE							
FLUORENE							
INDENO(1,2,3-CD)PYRENE							
NAPHTHALENE							
PHENANTHRENE							
PYRENE							
Pesticides/PCBs (ug/kg)							
4,4'-DDD	5.5 U	2.7 J	2.1 J	7.8 U	19 U	58	12 J
4,4'-DDE	1.2 J	1.7 J	2.8 J	4.2 J	4.8 J	26	12 J
4,4'-DDT	5.5 U	1.3 J	4.3 U	7.8 U	19 U	3.8 J	3.8 J
ALPHA-CHLORDANE	2.8 U	3.2 U	2.2 U	4.0 U	9.6 U	2.8 J	5.8 UJ
AROCLOR-1016							
AROCLOR-1221							
AROCLOR-1232							
AROCLOR-1242							
AROCLOR-1248							
AROCLOR-1254							
AROCLOR-1260							
GAMMA-CHLORDANE	3.4	3.2 U	2.2 U	2.0 J	9.6 U	3.8 U	5.8 UJ
Inorganics (mg/kg)							
ARSENIC	3.6	5.1	1.9	1.6	4.5 J	2.3	3.5 J
COPPER	4.1	5.6	4.2	6.8	7.6 J	7.6	13.2 J
LEAD	10	13.7	23.2	14.6	17.2 J	36.4	44.9 J
MERCURY	0.04	0.05	0.04	0.16	0.16 J	0.15	0.14 J
ZINC	20.4	25.9	49.4	65.4	93.3 J	38.1	78.0 J
Miscellaneous Parameters (%)							
TOTAL SOLIDS	60.1	53.6	76.3	42.2	17.7	44.2	29

C-2 2003 SEDIMENT SAMPLES

Sample 6003 FY 2003 Project: 03-0504

SPECIFIED TESTS

Facility: US MCRD Parris Island Parris Island, SC

Program: SF Case No: 31611

Id/Station: 03SD61 / MD No: 1WT0 Inorg Contractor: BONNER

Media: SEDIMENT

Produced by: Goddard, Denise
Requestor:
Project Leader: RPOPE
Beginning: 04/14/2003 10:45
Ending:

RESULTS	UNITS	ANALYTE
5.3 J	MG/KG	Arsenic
13 J	MG/KG	Lead
0.20 U	MG/KG	Total Mercury
36	%	% Moisture

U-Analyte not detected at or above reporting limit. | J-Identification of analyte is acceptable; reported value is an estimate. | UJ-Analyte not detected at or above reporting limit. Reporting limit is an estimate.
N-Presumptive evidence analyte is present; analyte reported as tentative identification. | NJ-Presumptive evidence analyte is present; analyte reported as tentative identification. Reported value is an estimate.
K-Identification of analyte is acceptable; reported value may be biased high. Actual value expected to be less than the reported value.
L-Identification of analyte is acceptable; reported value may be biased low. Actual value expected to be greater than reported value.
NA-Not Analyzed. | NAI-Not Analyzed due to Interferences. | A-Analyte analyzed in replicate. Reported value is "average" of replicates.
R-Presence or absence of analyte can not be determined from data due to severe quality control problems. Data are rejected and considered unusable.

Sample 6066 FY 2003 Project: 03-0504

SPECIFIED TESTS

Facility: US MCRD Parris Island Parris Island, SC
Program: SF Case No: 31611
Id/Station: 03SD62 / MD No: 1WT1 Inorg Contractor: BONNER
Media: SEDIMENT

Produced by: Goddard, Denise
Requestor:
Project Leader: RPOPE
Beginning: 04/14/2003 11:00
Ending:

DATA REPORTED ON DRY WEIGHT BASIS

RESULTS	UNITS	ANALYTE
5.3 J	MG/KG	Arsenic
18 J	MG/KG	Lead
0.20 U	MG/KG	Total Mercury
44	%	% Moisture

U-Analyte not detected at or above reporting limit. | J-Identification of analyte is acceptable; reported value is an estimate. | UJ-Analyte not detected at or above reporting limit. Reporting limit is an estimate.
N-Presumptive evidence analyte is present; analyte reported as tentative identification. | NJ-Presumptive evidence analyte is present; analyte reported as tentative identification. Reported value is an estimate.
K-Identification of analyte is acceptable; reported value may be biased high. Actual value expected to be less than the reported value.
L-Identification of analyte is acceptable; reported value may be biased low. Actual value expected to be greater than reported value.
NA-Not Analyzed. | NAI-Not Analyzed due to Interferences. | A-Analyte analyzed in replicate. Reported value is "average" of replicates.
R-Presence or absence of analyte can not be determined from data due to severe quality control problems. Data are rejected and considered unusable.

Sample **6007** FY **2003** Project: **03-0504**

SPECIFIED TESTS

Facility: US MCRD Parris Island — Parris Island, SC
Program: SF — Case No: 31611
Id/Station: 03SD63 / — MD No: 1WT2 — Inorg Contractor: BONNER
Media: SEDIMENT

Produced by: Goddard, Denise
Requestor:
Project Leader: RPOPE
Beginning: 04/14/2003 11:15
Ending:

DATA REPORTED ON DRY WEIGHT BASIS

RESULTS	UNITS	ANALYTE
6.4 J	MG/KG	Arsenic
22 J	MG/KG	Lead
0.19 U	MG/KG	Total Mercury
43	%	% Moisture

U-Analyte not detected at or above reporting limit. | J-Identification of analyte is acceptable; reported value is an estimate. | UJ-Analyte not detected at or above reporting limit. Reporting limit is an estimate.
N-Presumptive evidence analyte is present; analyte reported as tentative identification. | NJ-Presumptive evidence analyte is present; analyte reported as tentative identification. Reported value is an estimate.
K-Identification of analyte is acceptable; reported value may be biased high. Actual value expected to be less than the reported value.
L-Identification of analyte is acceptable; reported value may be biased low. Actual value expected to be greater than reported value.
NA-Not Analyzed. | NAI-Not Analyzed due to Interferences. | A-Analyte analyzed in replicate. Reported value is "average" of replicates.
R-Presence or absence of analyte can not be determined from data due to severe quality control problems. Data are rejected and considered unusable.

Sample 5793 FY **2003** Project: **03-0464**

DDT Scan

Facility: US MCRD Parris Island Parris Island, SC

Program: SF

Id/Station: 61-01 / PAI03SD6101

Media: SEDIMENT

Produced by: Revells, Lavon

Requestor:

Project Leader: RPOPE

Beginning: 04/14/2003 10:45

Ending:

DATA REPORTED ON DRY WEIGHT BASIS

RESULTS	UNITS	ANALYTE
13 U	UG/KG	4,4'-DDT (p,p'-DDT)
5.2 J	UG/KG	4,4'-DDE (p,p'-DDE)
5.7 J	UG/KG	4,4'-DDD (p,p'-DDD)
13 U	UG/KG	2,4'-DDT (o,p'-DDT)
5.2 U	UG/KG	2,4'-DDE (o,p'-DDE)
13 U	UG/KG	2,4'-DDD (o,p'-DDD)
11 J	UG/KG	Total DDT Residues (TDDTR)
36	%	% Moisture

U-Analyte not detected at or above reporting limit. | J-Identification of analyte is acceptable; reported value is an estimate. | UJ-Analyte not detected at or above reporting limit. Reporting limit is an estimate.
N-Presumptive evidence analyte is present; analyte reported as tentative identification. | NJ-Presumptive evidence analyte is present; analyte reported as tentative identification. Reported value is an estimate.
K-Identification of analyte is acceptable; reported value may be biased high. Actual value expected to be less than the reported value.
L-Identification of analyte is acceptable; reported value may be biased low. Actual value expected to be greater than reported value.
NA-Not Analyzed. | NAI-Not Analyzed due to Interferences. | A-Analyte analyzed in replicate. Reported value is "average" of replicates.
R-Presence or absence of analyte can not be determined from data due to severe quality control problems. Data are rejected and considered unusable.
C-confirmed by GCMS | /1-when no value is reported, see chlordane constituents | /2-constituents or metabolites of technical chlordane

Sample **5794** FY **2003** Project: **03-0464**

DDT Scan

Facility: US MCRD Parris Island Parris Island, SC
Program: SF
Id/Station: 62-01 / PAI03SD62-01
Media: SEDIMENT

Produced by: Revells, Lavon
Requestor:
Project Leader: RPOPE
Beginning: 04/14/2003 11:00
Ending:

DATA REPORTED ON DRY WEIGHT BASIS

RESULTS	UNITS	ANALYTE
16 U	UG/KG	4,4'-DDT (p,p'-DDT)
2.8 J	UG/KG	4,4'-DDE (p,p'-DDE)
4.9 J	UG/KG	4,4'-DDD (p,p'-DDD)
16 U	UG/KG	2,4'-DDT (o,p'-DDT)
6.2 U	UG/KG	2,4'-DDE (o,p'-DDE)
16 U	UG/KG	2,4'-DDD (o,p'-DDD)
7.7 J	UG/KG	Total DDT Residues (TDDTR)
48	%	% Moisture

U-Analyte not detected at or above reporting limit. | J-Identification of analyte is acceptable; reported value is an estimate. | UJ-Analyte not detected at or above reporting limit. Reporting limit is an estimate.
N-Presumptive evidence analyte is present; analyte reported as tentative identification. | NJ-Presumptive evidence analyte is present; analyte reported as tentative identification. Reported value is an estimate.
K-Identification of analyte is acceptable; reported value may be biased high. Actual value expected to be less than the reported value.
L-Identification of analyte is acceptable; reported value may be biased low. Actual value expected to be greater than reported value.
NA-Not Analyzed. | NAI-Not Analyzed due to Interferences. | A-Analyte analyzed in replicate. Reported value is "average" of replicates.
R-Presence or absence of analyte can not be determined from data due to severe quality control problems. Data are rejected and considered unusable.
C-confirmed by GCMS | /1-when no value is reported, see chlordane constituents | /2-constituents or metabolites of technical chlordane

Sample 5... FY **2003** Project: **03-0464**

DDT Scan

Facility: US MCRD Parris Island Parris Island, SC

Program: SF

Id/Station: 63-01 / PAI03SD63-01

Media: SEDIMENT

Produced by: Revells, Lavon

Requestor:

Project Leader: RPOPE

Beginning: 04/14/2003 11:15

Ending:

DATA REPORTED ON DRY WEIGHT BASIS

RESULTS	UNITS	ANALYTE
12 U	UG/KG	4,4'-DDT (p,p'-DDT)
2.5 J	UG/KG	4,4'-DDE (p,p'-DDE)
12 U	UG/KG	4,4'-DDD (p,p'-DDD)
12 U	UG/KG	2,4'-DDT (o,p'-DDT)
4.7 U	UG/KG	2,4'-DDE (o,p'-DDE)
12 U	UG/KG	2,4'-DDD (o,p'-DDD)
2.5 J	UG/KG	Total DDT Residues (TDDTR)
31	%	% Moisture

U-Analyte not detected at or above reporting limit. | J-Identification of analyte is acceptable; reported value is an estimate. | UJ-Analyte not detected at or above reporting limit. Reporting limit is an estimate.
N-Presumptive evidence analyte is present; analyte reported as tentative identification. | NJ-Presumptive evidence analyte is present; analyte reported as tentative identification. Reported value is an estimate.
K-Identification of analyte is acceptable; reported value may be biased high. Actual value expected to be less than the reported value.
L-Identification of analyte is acceptable; reported value may be biased low. Actual value expected to be greater than reported value.
NA-Not Analyzed. | NAI-Not Analyzed due to Interferences. | A-Analyte analyzed in replicate. Reported value is "average" of replicates.
R-Presence or absence of analyte can not be determined from data due to severe quality control problems. Data are rejected and considered unusable.
C-confirmed by GCMS | /1-when no value is reported, see chlordane constituents | /2-constituents or metabolites of technical chlordane

CLASSICALS/NUTRIENTS SAMPLE ANALYSIS **EPA - REGION IV SESD, ATHENS, GA** **Production Date: 05/29/2003 13:[illegible]5**

Sample 7[illegible] FY **2003** Project: **03-0465**

SPECIFIED TESTS

Facility: US MCRD Parris Island Parris Island, SC

Program: SF

Id/Station: 03SD61 / MD No: SD61

Media: SEDIMENT

SAS Number:TOC

Inorg Contractor: ACCU

Produced by: Goddard, Denise

Requestor:

Project Leader: RPOPE

Beginning: 04/14/2003 10:45

Ending:

RESULTS	UNITS	ANALYTE
NA		Geotech Parameters
6700	MG/KG	Total Organic Carbon
32	%	% Moisture

Data Reported by Memo

U-Analyte not detected at or above reporting limit. | J-Identification of analyte is acceptable; reported value is an estimate. | UJ-Analyte not detected at or above reporting limit. Reporting limit is an estimate.
N-Presumptive evidence analyte is present; analyte reported as tentative identification. | NJ-Presumptive evidence analyte is present; analyte reported as tentative identification. Reported value is an estimate.
K-Identification of analyte is acceptable; reported value may be biased high. Actual value expected to be less than the reported value.
L-Identification of analyte is acceptable; reported value may be biased low. Actual value expected to be greater than reported value.
NA-Not Analyzed. | NAI-Not Analyzed due to Interferences. | A-Analyte analyzed in replicate. Reported value is "average" of replicates.
R-Presence or absence of analyte can not be determined from data due to severe quality control problems. Data are rejected and considered unusable.

Sample **7318** FY **2003** Project: **03-0465**

Produced by: Goddard, Denise
Requestor:
Project Leader: RPOPE
Beginning: 04/14/2003 11:00
Ending:

SPECIFIED TESTS

Facility: US MCRD Parris Island Parris Island, SC
Program: SF
Id/Station: 03SD62 / MD No: SD62
Media: SEDIMENT

SAS Number:TOC
Inorg Contractor: ACCU

RESULTS	UNITS	ANALYTE
NA		Geotech Parameters
11000	MG/KG	Total Organic Carbon
46	%	% Moisture

Data Reported by Memo

U-Analyte not detected at or above reporting limit. | J-Identification of analyte is acceptable; reported value is an estimate. | UJ-Analyte not detected at or above reporting limit. Reporting limit is an estimate.
N-Presumptive evidence analyte is present; analyte reported as tentative identification. | NJ-Presumptive evidence analyte is present; analyte reported as tentative identification. Reported value is an estimate.
K-Identification of analyte is acceptable; reported value may be biased high. Actual value expected to be less than the reported value.
L-Identification of analyte is acceptable; reported value may be biased low. Actual value expected to be greater than reported value.
NA-Not Analyzed. | NAI-Not Analyzed due to Interferences. | A-Analyte analyzed in replicate. Reported value is "average" of replicates.
R-Presence or absence of analyte can not be determined from data due to severe quality control problems. Data are rejected and considered unusable.

Sample **7319** FY **2003** Project: **03-0465**

SPECIFIED TESTS

Facility: US MCRD Parris Island Parris Island, SC

Program: SF

Id/Station: 03SD63 / MD No: SD63

Media: SEDIMENT

SAS Number: TOC

Inorg Contractor: ACCU

Produced by: Goddard, Denise

Requestor:

Project Leader: RPOPE

Beginning: 04/14/2003 11:15

Ending:

RESULTS	UNITS	ANALYTE
NA		Geotech Parameters
15000	MG/KG	Total Organic Carbon
42	%	% Moisture

Data Reported by Memo

U-Analyte not detected at or above reporting limit. | J-Identification of analyte is acceptable; reported value is an estimate. | UJ-Analyte not detected at or above reporting limit. Reporting limit is an estimate.
N-Presumptive evidence analyte is present; analyte reported as tentative identification. | NJ-Presumptive evidence analyte is present; analyte reported as tentative identification. Reported value is an estimate.
K-Identification of analyte is acceptable; reported value may be biased high. Actual value expected to be less than the reported value.
L-Identification of analyte is acceptable; reported value may be biased low. Actual value expected to be greater than reported value.
NA-Not Analyzed. | NAI-Not Analyzed due to Interferences. | A-Analyte analyzed in replicate. Reported value is "average" of replicates.
R-Presence or absence of analyte can not be determined from data due to severe quality control problems. Data are rejected and considered unusable.

C-3 2009 FISH TISSUE SAMPLES

TABLE C-3.1

3RD BATTALION POND FISH TISSUE DATA - OCTOBER 2009
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

SAMPLE LOCATION	03BATPOND-Q1	03BATPOND-Q1	03BATPOND-Q1	03BATPOND-Q1
SAMPLE NUMBER	PAI-03-RD-01-02	PAI-03-RD-01-03	PAI-03-MU-01-01	PAI-03-MU-01-04
SAMPLE DATE	20091028	20091028	20091027	20091028
METALS (MG/KG)				
COPPER	0.26 U	0.34 U	0.25 U	0.22 U
MERCURY	0.0878 U	0.0482 U	0.0024 U	0.0068 U
PCB HOMOLOGS (NG/KG)				
PCB-105	44.4	34.6	220	152
PCB-114	5.47 U	4.17 U	8.09 U	11.3 U
PCB-118	171	126	1040	729
PCB-123	4.88 U	3.46 U	11.1 J	11.8 J
PCB-126	6.48 U	4.71 U	9.86 U	12.6 U
PCB-156/157	16.6	12.8	123	73.6
PCB-167	9.7	6.47	83.3	52.2 J
PCB-169	7.15 U	6.47 U	10.2 U	7.63 U
PCB-189	3.12 U	3.42 U	13.8 J	9.39 J
PCB-77	4.49 U	4.17 U	29.5	16.8 J
PCB-81	3.67 U	3.67 U	6.2 U	6.58 U
TEQ PCB	0.007251	0.005396	0.047686	0.032519
TEQ PCB - HALFND	0.439476	0.338868	0.694737	0.778125
TOTAL PCB	241.7	179.87	1520.7	1044.79
TOTAL PCB - HALFND	259.33	194.905	1537.875	1063.845
PESTICIDES (UG/KG)				
4,4'-DDD	0.34 UJ	0.36 UJ	0.38 UJ	2.4 J
4,4'-DDE	2.2 J	1.5 J	6.2 J	7.9 J
4,4'-DDT	0.34 UJ	0.36 UJ	2.4 J	2.2 J
MISCELLANEOUS PARAMETERS (%)				
LIPIDS	0.26	0.38	2.7	1.4
TOTAL SOLIDS	21	21	23	24
MISCELLANEOUS PARAMETERS				
FILLET DATE	20091029	20091029	20091028	20091029
HOMOGENIZED DATE	20091030	20091030	20091029	20091030
FILLET USED	LEFT	BOTH	BOTH	LEFT
BLENDER ID	M1	M1	M1	M1
SEX	FEMALE	FEMALE	FEMALE	FEMALE
SPECIES	RED DRUM	RED DRUM	MULLET	MULLET
LENGTH (CM)	48.8	33.8	33.9	48
WEIGHT (G)	1100	382	370	1050
AGE (YEARS)	2	1	3	>4

TABLE C-3.1

3RD BATTALION POND FISH TISSUE DATA - OCTOBER 2009
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

SAMPLE LOCATION	03BATPOND-Q2	03BATPOND-Q2	03BATPOND-Q2	03BATPOND-Q2	03BATPOND-Q2	03BATPOND-Q2
SAMPLE NUMBER	PAI-03-RD-02-01	PAI-03-BD-02-05	PAI-03-BD-02-06	PAI-03-BD-02-07	PAI-03-MU-02-02	PAI-03-MU-02-04
SAMPLE DATE	20091026	20091028	20091028	20091028	20091026	20091028
METALS (MG/KG)						
COPPER	0.4 U	0.23 U	0.22 U	0.24 U	0.71 U	0.62 U
MERCURY	0.106 U	0.0204	0.0155	0.0172	0.0038 U	0.0019 U
PCB HOMOLOGS (NG/KG)						
PCB-105	68	45.3	61	51.4	718	708
PCB-114	3.54 U	5.8 U	5.46 U	3.97 U	38.6	42.2
PCB-118	300	200	249	194	3500 J	3320
PCB-123	3.34 U	5.43 U	5.08 U	4.28 J	40.5	30.8 J
PCB-126	4.58 U	7.52 U	5.89 U	4.75 U	39.9 J	14.3 U
PCB-156/157	35.1	18.9	32.3	23.7	414	375
PCB-167	19.9	15.6	25.2	18.6	320	278
PCB-169	7.83 U	7.07 U	9.82 U	10.8 U	10.8 U	12.5 U
PCB-189	2.68 U	3.29 U	3.46 U	2.83 U	65.3 J	51.1
PCB-77	3.47 U	9.47 U	5.9 U	4.48 U	86.1	77
PCB-81	3.5 U	8.36 U	4.05 U	4.41 U	8.26 U	8.95 U
TEQ PCB	0.01269	0.008394	0.011025	0.008759	4.151502	0.151853
TEQ PCB - HALFND	0.359981	0.492388	0.453935	0.409245	4.314741	1.055695
TOTAL PCB	423	279.8	367.5	291.98	5222.4	4882.1
TOTAL PCB - HALFND	437.47	303.27	387.33	307.6	5231.93	4899.975
PESTICIDES (UG/KG)						
4,4'-DDD	2.4 J	0.35 UJ	0.38 UJ	0.42 UJ	11 J	4.3 J
4,4'-DDE	3.4 J	2 J	3 J	2.5 J	50 J	28 J
4,4'-DDT	2.4 J	1.6 J	0.38 UJ	2.2 J	5.6 J	3.9 J
MISCELLANEOUS PARAMETERS (%)						
LIPIDS	0.37	0.53	0.56	0.47	7.4	5.1
TOTAL SOLIDS	22	22	20	22	28	26
MISCELLANEOUS PARAMETERS						
FILLET DATE	20091027	20091029	20091029	20091029	20091027	20091029
HOMOGENIZED DATE	20091029	20091030	20091030	20091030	20091029	20091030
FILLET USED	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT
BLENDER ID	M1	M1	M1	M1	M1	M1
SEX	FEMALE	FEMALE	FEMALE	MALE	MALE	MALE
SPECIES	RED DRUM	BLACK DRUM	BLACK DRUM	BLACK DRUM	MULLET	MULLET
LENGTH (CM)	54.3	37	39.7	39.2	38.3	47.2
WEIGHT (G)	1353	656	868	901	626	1180
AGE (YEARS)	2	2	2	2	3-4	>4

TABLE C-3.1

3RD BATTALION POND FISH TISSUE DATA - OCTOBER 2009
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

SAMPLE LOCATION SAMPLE NUMBER SAMPLE DATE	03BATPOND-Q3 PAI-03-RD-03-03 20091027	03BATPOND-Q3 PAI-03-RD-03-04 20091027	03BATPOND-Q3 PAI-03-MU-03-01 20091027	03BATPOND-Q3 PAI-03-MU-03-02 20091027
METALS (MG/KG)				
COPPER	0.33 U	0.32 U	0.35 U	0.43 U
MERCURY	0.125	0.421	0.003 U	0.003 U
PCB HOMOLOGS (NG/KG)				
PCB-105	346	157	444	638
PCB-114	16.7	7.1 U	26.1	37.1
PCB-118	1580	644	2180	3000
PCB-123	11.5 J	6.92 U	25.6 J	26.6 J
PCB-126	9.09 U	7.79 U	17.8 U	27.8 U
PCB-156/157	133	44.2	209	350
PCB-167	101	33.2	157	261
PCB-169	9.65 U	6.24 U	14.1 U	19.9 U
PCB-189	4.7 U	2.38 U	26.2 J	52.9 J
PCB-77	22.2	7.21	61.4	57.8
PCB-81	6.58 U	5.66 U	9.52 U	11.8 U
TEQ PCB	0.067866	0.027073	0.098177	0.136748
TEQ PCB - HALFND	0.668173	0.511266	1.201105	1.827018
TOTAL PCB	2210.4	885.61	3129.3	4423.4
TOTAL PCB - HALFND	2225.41	903.655	3150.01	4453.15
PESTICIDES (UG/KG)				
4,4'-DDD	3.7 J	0.36 UJ	3.6 J	5.6 J
4,4'-DDE	15 J	3.9 J	17 J	32 J
4,4'-DDT	0.42 UJ	2 J	3 J	4.2 UJ
MISCELLANEOUS PARAMETERS (%)				
LIPIDS	1.1	0.33	6.2	4.8
TOTAL SOLIDS	25	20	27	27
MISCELLANEOUS PARAMETERS				
FILLET DATE	20091028	20091029	20091028	20091028
HOMOGENIZED DATE	20091104	20091104	20091029	20091029
FILLET USED	LEFT	LEFT	BOTH	LEFT
BLENDER ID	B1	B1	M1	M1
SEX	FEMALE	FEMALE	FEMALE	MALE
SPECIES	RED DRUM	RED DRUM	MULLET	MULLET
LENGTH (CM)	82	92.5	36	38.5
WEIGHT (G)	5800	7600	489	591
AGE (YEARS)	4-5	5-8	3	3-4

TABLE C-3.1

3RD BATTALION POND FISH TISSUE DATA - OCTOBER 2009
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

SAMPLE LOCATION	03BATPOND-Q4	03BATPOND-Q4	03BATPOND-Q4	03BATPOND-Q4
SAMPLE NUMBER	PAI-03-RD-04-01	PAI-03-RD-04-01-AVG	PAI-03-RD-04-01-D	PAI-03-RD-04-02
SAMPLE DATE	20091026	20091026	20091026	20091026
METALS (MG/KG)				
COPPER	0.55 U	0.505 U	0.46 U	0.33 U
MERCURY	0.564	0.56	0.556	0.0445
PCB HOMOLOGS (NG/KG)				
PCB-105	394	374	354	68.3
PCB-114	16.8	10.64	8.96 U	5.84 U
PCB-118	1820	1695	1570	250
PCB-123	13.1 U	9.825	13.1	4.96 U
PCB-126	18.9 J	17.25 J	15.6	6.57 U
PCB-156/157	132	125	118	41.2
PCB-167	105	97.05	89.1	21.8
PCB-169	9.61 U	10.105 U	10.6 U	6.62 U
PCB-189	4.52 U	4.105 U	3.69 U	2.94 U
PCB-77	10.3	9.95	9.6	4.7 U
PCB-81	7.66 U	6.995 U	6.33 U	4.01 U
TEQ PCB	1.965064	1.795339	1.625286	0.011439
TEQ PCB - HALFND	2.110626	1.948024	1.785424	0.44028
TOTAL PCB	2497	2338.715	2169.4	381.3
TOTAL PCB - HALFND	2514.445	2349.3175	2184.19	399.12
PESTICIDES (UG/KG)				
4,4'-DDD	4 J	3.55 J	3.1 J	0.38 UJ
4,4'-DDE	24 J	22 J	20 J	5 J
4,4'-DDT	3.9 J	3.6 J	3.3 J	3.1 J
MISCELLANEOUS PARAMETERS (%)				
LIPIDS	0.42	0.375	0.33	0.15
TOTAL SOLIDS	22	21.5	21	20
MISCELLANEOUS PARAMETERS				
FILLET DATE	20091027	20091027	20091027	20091027
HOMOGENIZED DATE	20091104	20091104	20091104	20091029
FILLET USED	LEFT	RIGHT	RIGHT	BOTH
BLENDER ID	B1	B1	B1	M1
SEX	FEMALE	FEMALE	FEMALE	FEMALE
SPECIES	RED DRUM	RED DRUM	RED DRUM	RED DRUM
LENGTH (CM)	96	NA	NA	32.2
WEIGHT (G)	9100	NA	NA	309
AGE (YEARS)	5-8	NA	NA	1

TABLE C-3.1

3RD BATTALION POND FISH TISSUE DATA - OCTOBER 2009
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 5 OF 5

SAMPLE LOCATION	03BATPOND-Q4	03BATPOND-Q4	03BATPOND-Q4	03BATPOND-Q4
SAMPLE NUMBER	PAI-03-MU-04-03	PAI-03-MU-04-04	PAI-03-MU-04-04-AVG	PAI-03-MU-04-04-D
SAMPLE DATE	20091026	20091026	20091026	20091026
METALS (MG/KG)				
COPPER	0.48 U	0.38 U	0.37 U	0.36 U
MERCURY	0.0037 U	0.002 U	0.0022 U	0.0024 U
PCB HOMOLOGS (NG/KG)				
PCB-105	813	1010	938	866
PCB-114	45.9	61	61.2	61.4
PCB-118	3980	5080 J	4660 J	4240 J
PCB-123	39	57.5 J	33.55 J	19.2 UJ
PCB-126	47.6	61.3 J	37.825 J	28.7 UJ
PCB-156/157	482	731	656	581
PCB-167	372	572 J	531.5 J	491
PCB-169	9.8 UJ	19.9 J	19.9 J	48.9 U
PCB-189	75.6	125	128	131
PCB-77	101	89.4	89.3	89.2
PCB-81	10.3 U	9.35 U	7.1 J	7.1 J
TEQ PCB	4.944325	6.965035	4.600807	0.202162
TEQ PCB - HALFND	5.09287	6.966437	4.600807	2.37095
TOTAL PCB	5956.1	7807.1	7162.375	6466.7
TOTAL PCB - HALFND	5966.15	7811.775	7162.375	6515.1
PESTICIDES (UG/KG)				
4,4'-DDD	14 J	11 J	9.45 J	7.9 J
4,4'-DDE	48 J	71 J	64.5 J	58 J
4,4'-DDT	6.3 J	7.2 J	6.5 J	5.8 J
MISCELLANEOUS PARAMETERS (%)				
LIPIDS	7.8	5.9	5.35	4.8
TOTAL SOLIDS	28	28	27	26
MISCELLANEOUS PARAMETERS				
FILLET DATE	20091027	20091027	20091027	20091027
HOMOGENIZED DATE	20091029	20091029	20091029	20091029
FILLET USED	LEFT	LEFT	RIGHT	RIGHT
BLENDER ID	M1	M1	M1	M1
SEX	MALE	MALE	MALE	MALE
SPECIES	MULLET	MULLET	MULLET	MULLET
LENGTH (CM)	41.7	52	NA	NA
WEIGHT (G)	835	1600	NA	NA
AGE (YEARS)	>4	>4	NA	NA

TABLE C-3.2

GENERAL'S CROSSING CREEK FISH TISSUE DATA - OCTOBER 2009
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 1 OF 2

SAMPLE LOCATION	03BATPOND-RF	03BATPOND-RF	03BATPOND-RF	03BATPOND-RF	03BATPOND-RF	03BATPOND-RF
SAMPLE NUMBER	PAI-03-BD-RF-01	PAI-03-RD-RF-06	PAI-03-RD-RF-07	PAI-03-RD-RF-07-AVG	PAI-03-RD-RF-07-D	PAI-03-RD-RF-08
SAMPLE DATE	20091029	20091030	20091031	20091031	20091031	20091031
METALS (MG/KG)						
COPPER	0.62 U	2.4 U	0.58 U	0.59 U	0.6 U	0.61 U
MERCURY	0.0235	0.0866 U	0.0684 U	0.0647 U	0.061 U	0.0571 U
PCB HOMOLOGS (NG/KG)						
PCB-105	77.7	49.8	51.5	46.35	41.2	319
PCB-114	4.66 U	6.34 U	5.46 U	4.855 U	4.25 U	23
PCB-118	204	154	155	146.5	138	1050
PCB-123	3.51 U	6.25 U	5.29 U	4.51 U	3.73 U	14.5 J
PCB-126	4.6 U	8.67 U	6.37 U	5.605 U	4.84 U	9.97 U
PCB-156/157	13.2	21.7	18.3	17.05	15.8	159
PCB-167	9	13.4	11 J	10.6 J	10.2	54.4
PCB-169	4.57 U	5.56 U	3.64 U	3.57 U	3.5 U	7.3 U
PCB-189	1.83 U	2.42 UJ	2.23 U	2.165 U	2.1 U	2.34 U
PCB-77	13.6	4.74 U	6.15 J	5.845 J	5.54	8.81
PCB-81	4.45 U	4.9 U	3.98 U	3.46 U	2.94 U	4.51 U
TEQ PCB	0.010477	0.007167	0.007689	0.007198	0.00671	0.049478
TEQ PCB - HALFND	0.309842	0.525263	0.381579	0.341688	0.3018	0.658189
TOTAL PCB	317.5	238.9	241.95	226.345	210.74	1628.71
TOTAL PCB - HALFND	329.31	258.34	255.435	238.4275	221.42	1640.77
PESTICIDES (UG/KG)						
4,4'-DDD	0.4 UJ	0.35 UJ	0.36 UJ	0.38 UJ	0.4 UJ	0.31 UJ
4,4'-DDE	1.7 J	0.31 UJ	1.6 J	0.8875 J	0.35 UJ	1.5 J
4,4'-DDT	0.4 UJ	0.35 UJ	0.36 UJ	0.38 UJ	0.4 UJ	1.3 J
MISCELLANEOUS PARAMETERS (%)						
LIPIDS	0.91	0.53	1.3	1.25	1.2	1
TOTAL SOLIDS	22	21	23	23	23	22
MISCELLANEOUS PARAMETERS						
FILLET DATE	20091102	20091031	20091104	20091104	20091104	20091104
HOMOGENIZED DATE	20091104	20091104	20091104	20091104	20091104	20091104
FILLET USED	BOTH	LEFT	LEFT	RIGHT	RIGHT	LEFT
BLENDER ID	M1	B1	M1	M1	M1	M1
SEX	FEMALE	FEMALE	FEMALE	FEMALE	FEMALE	FEMALE
SPECIES	BLACK DRUM	RED DRUM	RED DRUM	RED DRUM	RED DRUM	RED DRUM
LENGTH (CM)	27.2	59.3	40.5	NA	NA	40.1
WEIGHT (G)	290	2050	747	NA	NA	662
AGE (YEARS)	1-2	2	1-2	NA	NA	1-2

TABLE C-3.2

GENERAL'S CROSSING CREEK FISH TISSUE DATA - OCTOBER 2009
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

SAMPLE LOCATION	03BATPOND-RF	03BATPOND-RF	03BATPOND-RF	03BATPOND-RF	03BATPOND-RF
SAMPLE NUMBER	PAI-03-RD-RF-09	PAI-03-MU-RF-02	PAI-03-MU-RF-03	PAI-03-MU-RF-04	PAI-03-MU-RF-05
SAMPLE DATE	20091031	20091029	20091029	20091030	20091030
METALS (MG/KG)					
COPPER	0.54 U	0.96 U	1 U	1.1 U	0.76 U
MERCURY	0.0882 U	0.0043 U	0.0069 U	0.0054 U	0.0074 U
PCB HOMOLOGS (NG/KG)					
PCB-105	30.1	151	217	38	63.2
PCB-114	4.08 U	10.8 U	12.5	8.77 U	14.3 U
PCB-118	94.4	538	829	118	250
PCB-123	3.84 U	11.1	12.2	6.88 U	13.7 U
PCB-126	4.14 U	15.3 U	12.7 U	19.9 U	18.3 U
PCB-156/157	3.13 U	61.1	83.6	11.3 J	24.8 J
PCB-167	5.8 J	34.9	48.8	7.59 UJ	20.5
PCB-169	4.3 U	4.37 U	6.77 U	2.46 U	2.88 U
PCB-189	1.83 U	5.46 J	2.96 U	2.37 U	2.51
PCB-77	5.12	15.7	28.8	6.42 U	11.7 U
PCB-81	2.89 U	4.22 U	6.99 U	5.34 U	11.3 U
TEQ PCB	0.004421	0.025616	0.038973	0.005019	0.01083
TEQ PCB - HALFND	0.276545	0.856961	0.776615	1.038423	0.971729
TOTAL PCB	135.42	817.26	1231.9	167.3	361.01
TOTAL PCB - HALFND	147.525	834.605	1246.61	197.165	397.1
PESTICIDES (UG/KG)					
4,4'-DDD	0.28 UJ	0.42 UJ	0.3 UJ	1.5 J	0.29 UJ
4,4'-DDE	0.25 UJ	2.9 J	5.1 J	2.1 J	0.26 UJ
4,4'-DDT	0.28 UJ	0.42 UJ	0.3 UJ	0.34 UJ	0.29 UJ
MISCELLANEOUS PARAMETERS (%)					
LIPIDS	0.54	5.9	5.5	2.5	4.2
TOTAL SOLIDS	22	28	26	24	27
MISCELLANEOUS PARAMETERS					
FILLET DATE	20091104	20091102	20091102	20091031	20091031
HOMOGENIZED DATE	20091104	20091104	20091104	20091104	20091104
FILLET USED	BOTH	LEFT	BOTH	LEFT	LEFT
BLENDER ID	M1	M1	M1	M1	M1
SEX	FEMALE	MALE	MALE	MALE	FEMALE
SPECIES	RED DRUM	MULLET	MULLET	MULLET	MULLET
LENGTH (CM)	35.2	37.5	32	48.9	37.7
WEIGHT (G)	406	557	345	1182	468
AGE (YEARS)	1	3-4	3	>4	3-4

APPENDIX D

BACKGROUND/TYPICAL FACILITY PESTICIDE CONCENTRATIONS

APPENDIX D

BACKGROUND/TYPICAL FACILITY PESTICIDE CONCENTRATIONS

Background concentrations are concentrations of constituents found in media surrounding a waste site that are not influenced by site activities or releases. Background levels of chemicals can be categorized as one of two types: naturally occurring and anthropogenic levels. Naturally occurring levels are ambient concentrations of chemicals present in the environment that have not been influenced by humans. Examples include aluminum and manganese. Anthropogenic levels are concentrations of chemicals that are present in the environment due to man-made, non-site sources. Examples include airborne particulates from past or present industrial activities, fill and dredged material, proximity to highways and roads (vehicle emissions, debris thrown from cars or dumped by humans, etc.), pesticide application, and proximity to aircraft activity.

An evaluation of local background concentrations is appropriate at a cleanup site whenever it is suspected that certain contaminants detected above applicable cleanup criteria may be equal to, or less than, background concentrations.

The information presented in this appendix was initially presented in the Site 3 RFI/RI (Table 4-1, Appendix C-1, and Appendix F-4) and has been used in subsequent MCRD Parris Island documents to establish background conditions at MCRD Parris Island.

BACKGROUND SAMPLES

Inorganic background levels are based on samples collected from two areas that are remote from the investigative sites and other waste management activities at Parris Island. For each background area, sample locations were visually located in the field to confirm the absence of waste management activities and represent a range of undisturbed soil and sediment types. The two areas selected for background samples consisted of Pickney Island and an undeveloped area on the southern portion of Parris Island.

Table D-1 provides a description of the background samples and the locations are shown on the attached Figures (as presented in Appendix A-12 in the Site 3 RFI/RI).

Six background samples were collected for all media of concern, except groundwater. Positive detections were noted for most parameters (see Table D-2). The values presented in Table D-2 are based on U.S.

EPA Region 4 protocol and equal 2 times the mean value. Table D-3 presents the complete set of analytical results for the background sediment samples.

TYPICAL FACILITY PESTICIDE CONCENTRATIONS SAMPLES

Introduction

As noted above, background samples were collected in 1998 from remote areas of Parris and Pinckney Islands. The sample locations are considered to be relatively remote from human activity. Based on limited access and a review of the surrounding area, the potential for local anthropogenic sources of TAL/TCL chemicals is limited. Pesticides were not detected in these background soil, sediment, and surface water samples, indicating that pesticides are not found uniformly throughout the region.

However, pesticides have been used at MCRD Parris Island for several decades to control insect populations. These chemicals have been applied in accordance with normal practices for control of insects. One reported distribution method was to fog an area with a truck mounted spray nozzle. Pesticides (including DDT) would then migrate as a mist and settle on adjacent vegetation and soils. Because of this practice, some pesticides may be present in soil and sediment at the base that are not related to waste management (NPL Sites and RCRA SWMUs). In addition, pesticides would mostly be used in recreational, training, and work areas (picnic grounds, parks, etc.) near stagnant water.

At sites/SWMUs where pesticides can be present from both disposal and insect control, an approach is needed to distinguish between these two potential sources. Otherwise, site-specific chemical data cannot be used to identify the extent of site/SWMU-related contamination.

MCRD Parris Island Data from Non-Pesticide Sites

Soil and sediment samples were collected at 8 sites at MCRD Parris Island in 1996. Additionally, two soil samples were collected in 1999 near the picnic area in the vicinity of Site 1. A listing of the sites and discussion of site histories are presented in Table D-4. Also presented in Table D-4 are recommendations for potential use of these sites as a background location for pesticides. Based on this review, data from Sites 5, 14, 15, and 21 and the picnic area near Site 1 were considered for use as local background (for pesticides). In addition, the background samples collected at the undeveloped area on the southern portion of Parris Island were included as background samples for pesticides.

The data for these sites are presented in Table D-5. Based on the results of the testing, six pesticides were detected at two or more sites. Of these pesticides, DDT was detected in 6 of 9 samples with detected concentrations ranging from 1.8 ug/kg to 70 ug/kg. 4,4'-DDD was detected in 1 of 9 samples, at a concentration of 160 ug/kg. 4,4'-DDE was detected in 6 of 9 samples with detected concentrations ranging from 3.8 J to 76 ug/kg. Chlordanes were detected in 2 of 9 samples with detected concentrations ranging from 1.6 ug/kg to 62 ug/kg. Endosulfan I was detected in 1 0f 9 samples at a concentration of 5.7 ug/kg.

<u>Typical Facility Pesticide Concentrations for MCRD Parris Island</u>

The data used to calculate the typical facility pesticide concentrations consists of data from Sites 5, 14, 15, and 21, the picnic area near Site 1, and 3 background sediment samples collected on Parris Island. The calculated arithmetic mean for each chemical is presented in Table D-5. To provide a reasonable estimate of the upper bound of these chemicals in soils and sediments, two times the arithmetic mean value is used. These values are also presented in Table D-5.

<u>Summary</u>

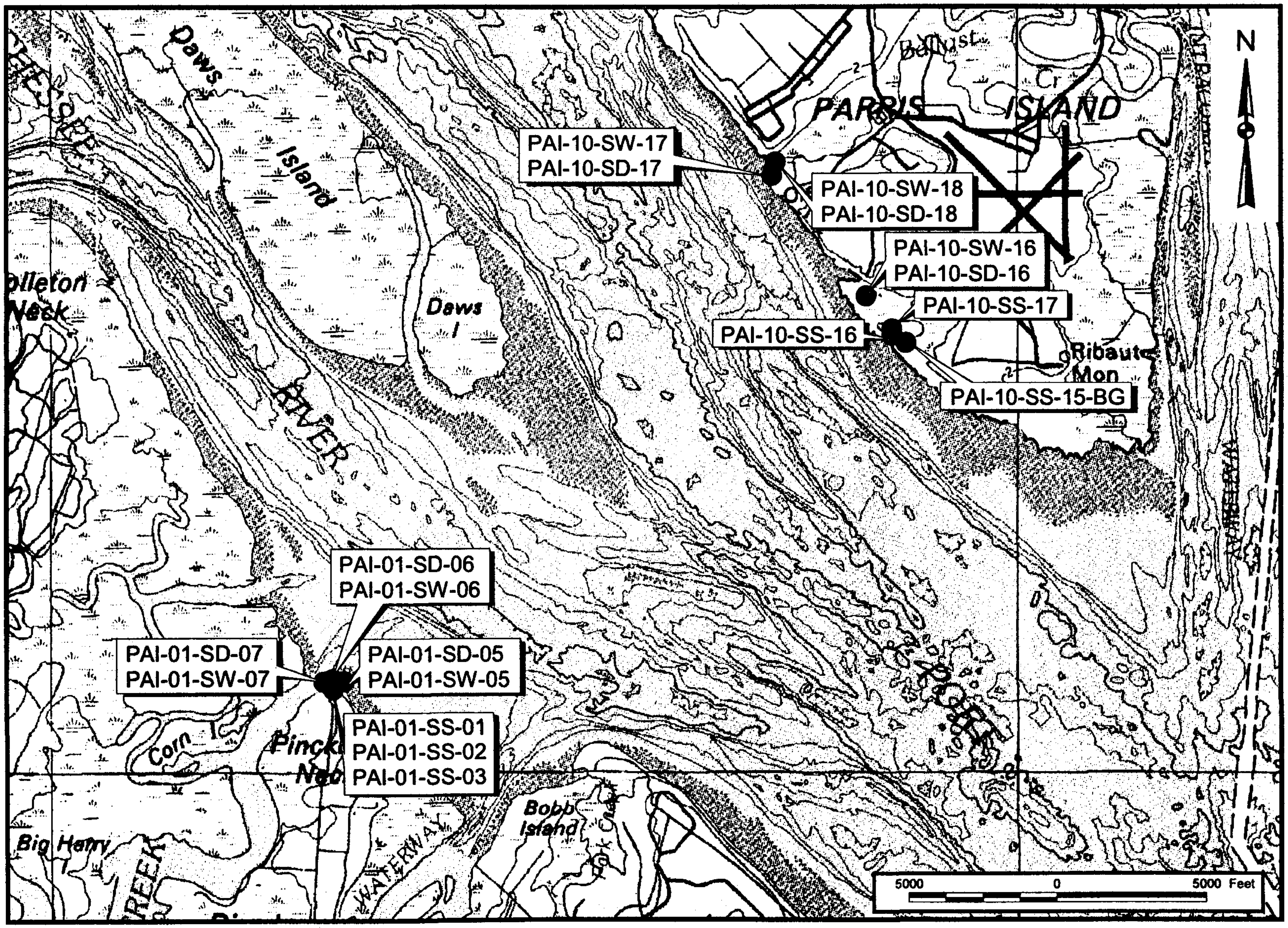
Based on the data presented in this memorandum, pesticides can be found at the base in areas used for recreation and work. The areas considered have not been identified as pesticide waste management areas, but are areas where insect control likely occurred. The absence of pesticides in several locations indicates that pesticides are not spread throughout the facility and as a result, pesticides would not be expected to be found at all locations. However, based on this evaluation, a finding of low concentrations of pesticides in one or more or more samples at a site should not be considered as conclusive evidence of site/SWMU-related contamination.

TABLE D-1

BACKGROUND SAMPLE DESCRIPTION
PARRIS AND PINCKNEY ISLANDS
MCRD PARRIS ISLAND, SOUTH CAROLINA

Sample Location	Sample Description
Surface Water	
PAI-01-SW-05*	Saline surface water sample collected on the northern edge of Pinckney Island at a submerged low tide elevation point.
PAI-01-SW-06*	Saline surface water sample collected in an intertidal area approximately 50 ft west of PAI-01-SW-05.
PAI-01-SW-07*	Saline surface water sample collected from flowing water at a point southwest of PAI-01-SW-05 and PAI-01-SW-06 over a high tide tidal flat in the marsh area.
PAI-10-SW-16	Saline surface water sample collected from a tidal stream adjacent to the Broad River, along the southwestern edge of Parris Island.
PAI-10-SW-17	Saline surface water sample collected from a tidal stream adjacent to the Broad River, along the southwestern edge of Parris Island.
PAI-10-SW-18	Saline surface water sample collected from a tidal stream adjacent to the Broad River, along the southwestern edge of Parris Island.
Sediment	
PAI-01-SD-05*	Sediment sample collected from the northern edge of Pinckney Island at a submerged low tide elevation point. Sample consisted of fine/medium grain sand.
PAI-01-SD-06*	Fine, medium grain sand sample collected in an intertidal area approximately 50 ft west of PAI-01-SD-05.
PAI-01-SD-07*	Collected from flowing water at a point west of PAI-01-SD-05 and PAI-01-SD-06, over a high tide tidal flat in the marsh area. Sample consisted of fine/medium grain sand.
PAI-10-SD-16	Silty clay sediment sample collected on the southwestern edge of Parris Island, near the Broad River
PAI-10-SD-17	Sediment sample with clay mud consistency collected approximately 500 ft south of the Ballast Creek on the southwestern edge of Parris Island.
PAI-10-SD-18	Sediment sample with clay mud consistency collected approximately 500 ft northeast of location PAI-10-SD-17.
Surface Soil	
PAI-01-SS-01*	Soil sample with fine/medium grain sand collected on the northern edge of Pinckney Island.
PAI-01-SS-02*	Located east of PAI-01-SS-01, consisting of fine/medium grain sand.
PAI-01-SS-03*	Fine/medium grain sand sample located southeast of PAI-01-SS-01.
PAI-10-SS-15	Silty, fine sand sample collected in a forest area on the southwestern edge of Parris Island.
PAI-10-SS-16	Collected in a forest area on the southwestern edge of Parris Island, approximately 600 ft northwest of PAI-01-SS-15. Surface soil sample consisted of silty fine sand.
PAI-10-SS-17	Silty, fine sand sample collected in a forest area on the southwestern edge of Parris Island, approximately 250 ft north of PAI-10-SS-16.

* Sample locations selected with input from the United States Fish and Wildlife Service.
Additional description of samples and locations are provided on sample log sheets.


N
PAI-10-SW-17
PAI-10-SD-17
PAI-10-SW-18
PAI-10-SD-18
PAI-10-SW-16
PAI-10-SD-16
PAI-10-SS-17
PAI-10-SS-16
PAI-10-SS-15-BG
PAI-01-SD-06
PAI-01-SW-06
PAI-01-SD-07
PAI-01-SW-07
PAI-01-SD-05
PAI-01-SW-05
PAI-01-SS-01
PAI-01-SS-02
PAI-01-SS-03
PARRIS ISLAND
Daws Island
Daws I
RIVER
Ribaut Mon
Bobb Island
Big Harry
WATERWAY
5000 0 5000 Feet

PAI-10-SW-17
PAI-10-SD-17
PAI-10-SW-18
PAI-10-SD-18
Airport
PAI-10-SW-16
PAI-10-SD-16
PAI-10-SS-17
PAI-10-SS-16
PAI-10-SS-15-BG
1000 0 1000 Feet
N

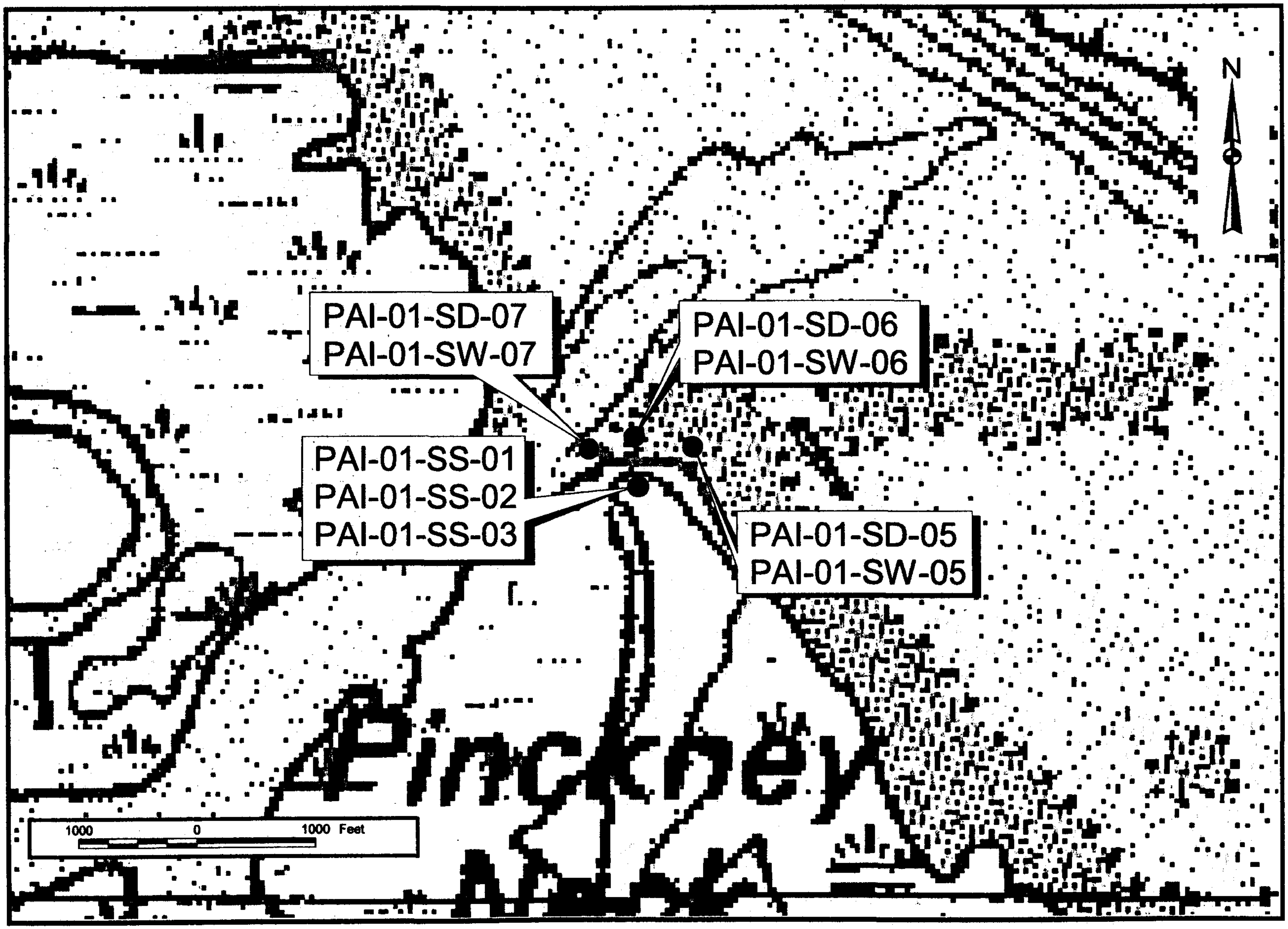

PAI-01-SD-07
PAI-01-SW-07
PAI-01-SD-06
PAI-01-SW-06
PAI-01-SS-01
PAI-01-SS-02
PAI-01-SS-03
PAI-01-SD-05
PAI-01-SW-05
Pinckney
N
1000
0
1000 Feet

TABLE D-2

SUMMARY OF DETECTED BACKGROUND CONCENTRATIONS
MCRD PARRIS ISLAND, SOUTH CAROLINA

Parameter	Surface Soil	Sediment	Surface Water Filtered	Surface Water Unfiltered
Organics	**(µg/kg)**	**(µg/kg)**	**(µg/l)**	**(µg/l)**
4-Methyl-2-pentanone	7.3	26		
2-Butanone		22		
Acetone	267			
Chloromethane				0.68
Carbon Disulfide		9.2		
Toluene	5.7	9.7		
Xylenes				1
Bis(2-Ethylhexyl)phthalate		421		45
Fluorene	646			
Indeno(1,2,3-cd)pyrene		518		2.6
Beta-BHC		7.1		
Inorganics	**(mg/kg)**	**(mg/kg)**	**(µg/l)**	**(µg/l)**
Aluminum	7270	24200		3100
Arsenic	1.4	12	4.3	5.1
Barium	24	28	256	38
Beryllium	0.095	0.98		
Cadmium		0.28		
Calcium	766	4000	650000	637000
Chromium	6.2	35.2	20	22.5
Cobalt	0.36	2.6		
Copper	1.5	10	13	7
Iron	3920	21500	48	2090
Lead	12.5	21	11	
Magnesium	515	6400	1900000	1900000
Manganese	129	186	18	53
Mercury	0.11	0.09		
Nickel	1.8	6		
Potassium	313	3200	890000	830000
Selenium	0.29			
Sodium	241	19000	15900000	16000000
Thallium	0.098	0.41		
Vanadium	9.5	50	15	18
Zinc	9.7	45	66	11

Background concentration is calculated as 2 times the average background concentration.

For chemicals in which at least one detection was noted, the average was calculated using 1/2 the detection limit for non detected chemicals.

Blank: Indicates that the chemical was not detected in any sample, and therefore an average could not be calculated.

Chemicals not detected in the background data set were not presented in this table. They include antimony, silver, and most organic compounds.

TABLE D-3

PARRIS ISLAND

BACKGROUND SEDIMENT - ANALYTICAL DATABASE

SAMPLE NUMBER:	PAI-01-SD-05-01	PAI-01-SD-06-01	PAI-01-SD-07-01	PAI-10-SD-016-01	PAI-10-SD-017-01	PAI-10-SD-018-01	
COLLECTION DATE:	05/27/98	05/27/98	05/27/98	09/09/98	09/09/98	09/09/98	/ /
LOCATION:	PAI-01-SD-005	PAI-01-SD-006	PAI-01-SD-007	PAI-10-SD-016	PAI-10-SD-017	PAI-10-SD-018	
SAMPLE DEPTH:	0.0 - 0.5'	0.0 - 0.5'	0.0 - 0.5'	0.0 - 0.5'	0.0 - 0.5'	0.0 - 0.5'	
VOLATILES (µg/kg)							
1,1,1-TRICHLOROETHANE	7 U	7 U	7 U	10 U	18 U	13 U	
1,1,2,2-TETRACHLOROETHANE	7 U	7 U	7 U	10 U	18 U	13 U	
1,1,2-TRICHLOROETHANE	7 U	7 U	7 U	10 U	18 U	13 U	
1,1-DICHLOROETHANE	7 U	7 U	7 U	10 U	18 U	13 U	
1,1-DICHLOROETHENE	7 U	7 U	7 U	10 U	18 U	13 U	
1,2-DICHLOROETHANE	7 U	7 U	7 U	10 U	18 U	13 U	
1,2-DICHLOROETHENE (TOTAL)	7 U	7 U	7 U	10 U	18 U	13 U	
1,2-DICHLOROPROPANE	7 U	7 U	7 U	10 U	18 U	13 U	
2-BUTANONE	7 U	7 U	7 U	16 U	38	21 U	
2-HEXANONE	7 U	7 U	7 U	16 U	31 U	21 U	
4-METHYL-2-PENTANONE	7 U	7 U	7 U	15 J	35	18 J	
ACETONE	7 UR	7 UR	7 UR	52 U	110 U	56 U	
BENZENE	7 U	7 U	7 U	10 U	18 U	13 U	
BROMODICHLOROMETHANE	7 U	7 U	7 U	10 U	18 U	13 U	
BROMOFORM	7 U	7 U	7 U	10 U	18 U	13 U	
BROMOMETHANE	7 U	7 U	7 U	10 U	18 U	13 U	
CARBON DISULFIDE	7 U	2 J	7 U	10 U	7 J	13 U	
CARBON TETRACHLORIDE	7 U	7 U	7 U	10 U	18 U	13 U	
CHLOROBENZENE	7 U	7 U	7 U	10 U	18 U	13 U	
CHLOROETHANE	7 U	7 U	7 U	10 U	18 U	13 U	
CHLOROFORM	7 U	7 U	7 U	10 U	18 U	13 U	
CHLOROMETHANE	7 U	7 U	7 U	10 U	18 U	13 U	
CIS-1,3-DICHLOROPROPENE	7 U	7 U	7 U	10 U	18 U	13 U	
DIBROMOCHLOROMETHANE	7 U	7 U	7 U	10 U	18 U	13 U	
ETHYLBENZENE	7 U	7 U	7 U	10 U	18 U	13 U	
METHYLENE CHLORIDE	7 U	7 U	7 U	20 U	29 U	19 U	
STYRENE	7 U	7 U	7 U	10 U	18 U	13 U	
TETRACHLOROETHENE	7 U	7 U	7 U	10 U	18 U	13 U	
TOLUENE	7 U	7 U	7 U	4 J	8 J	13 U	
TRANS-1,3-DICHLOROPROPENE	7 U	7 U	7 U	10 U	18 U	13 U	
TRICHLOROETHENE	7 U	7 U	7 U	10 U	18 U	13 U	

TABLE D-3

PARRIS ISLAND

BACKGROUND SEDIMENT - ANALYTICAL DATABASE

SAMPLE NUMBER:	PAI-01-SD-05-01	PAI-01-SD-06-01	PAI-01-SD-07-01	PAI-10-SD-016-01	PAI-10-SD-017-01	PAI-10-SD-018-01	
COLLECTION DATE:	05/27/98	05/27/98	05/27/98	09/09/98	09/09/98	09/09/98	/ /
LOCATION:	PAI-01-SD-005	PAI-01-SD-006	PAI-01-SD-007	PAI-10-SD-016	PAI-10-SD-017	PAI-10-SD-018	
SAMPLE DEPTH:	0.0 - 0.5'	0.0 - 0.5'	0.0 - 0.5'	0.0 - 0.5'	0.0 - 0.5'	0.0 - 0.5'	
VOLATILES (µg/kg)							
VINYL CHLORIDE	7 U	7 U	7 U	10 U	18 U	13 U	
XYLENES, TOTAL	7 U	7 U	7 U	10 U	18 U	13 U	
SEMIVOLATILES (µg/kg)							
1,2,4-TRICHLOROBENZENE	450 U	400 U	440 U	810 U	1200 U	1000 U	
1,2-DICHLOROBENZENE	450 U	400 U	440 U	810 U	1200 U	1000 U	
1,3-DICHLOROBENZENE	450 U	400 U	440 U	810 U	1200 U	1000 U	
1,4-DICHLOROBENZENE	450 U	400 U	440 U	810 U	1200 U	1000 U	
2,2'-OXYBIS(1-CHLOROPROPANE)	450 U	400 U	440 U	810 U	1200 U	1000 U	
2,4,5-TRICHLOROPHENOL	2300 U	2000 U	2200 U	810 U	1200 U	1000 U	
2,4,6-TRICHLOROPHENOL	450 U	400 U	440 U	810 U	1200 U	1000 U	
2,4-DICHLOROPHENOL	450 U	400 U	440 U	810 U	1200 U	1000 U	
2,4-DIMETHYLPHENOL	450 U	400 U	440 U	810 U	1200 U	1000 U	
2,4-DINITROPHENOL	2300 U	2000 U	2200 U	1600 U	2400 U	2100 U	
2,4-DINITROTOLUENE	450 U	400 U	440 U	810 U	1200 U	1000 U	
2,6-DINITROTOLUENE	450 U	400 U	440 U	810 U	1200 U	1000 U	
2-CHLORONAPHTHALENE	450 U	400 U	440 U	810 U	1200 U	1000 U	
2-CHLOROPHENOL	450 U	400 U	440 U	810 U	1200 U	1000 U	
2-METHYLNAPHTHALENE	450 U	400 U	440 U	810 U	1200 U	1000 U	
2-METHYLPHENOL	450 U	400 U	440 U	810 U	1200 U	1000 U	
2-NITROANILINE	2300 U	2000 U	2200 U	810 U	1200 U	1000 U	
2-NITROPHENOL	450 U	400 U	440 U	810 U	1200 U	1000 U	
3,3'-DICHLOROBENZIDINE	910 U	810 U	880 U	810 U	1200 U	1000 U	
3-NITROANILINE	2300 U	2000 U	2200 U	810 U	1200 U	1000 U	
4,6-DINITRO-2-METHYLPHENOL	2300 U	2000 U	2200 U	1600 U	2400 U	2100 U	
4-BROMOPHENYL PHENYL ETHER	450 U	400 U	440 U	810 U	1200 U	1000 U	
4-CHLORO-3-METHYLPHENOL	910 U	810 U	880 U	810 U	1200 U	1000 U	
4-CHLOROANILINE	450 U	400 U	440 U	810 U	1200 U	1000 U	
4-CHLOROPHENYL PHENYL ETHER	450 U	400 U	440 U	810 U	1200 U	1000 U	
4-METHYLPHENOL	450 U	400 U	440 U	810 U	1200 U	1000 U	
4-NITROANILINE	2300 U	2000 U	2200 U	810 U	1200 U	1000 U	
4-NITROPHENOL	2300 U	2000 U	2200 U	1600 U	2400 U	2100 U	

TABLE D-3

PARRIS ISLAND

BACKGROUND SEDIMENT - ANALYTICAL DATABASE

SAMPLE NUMBER: COLLECTION DATE: LOCATION: SAMPLE DEPTH:	PAI-01-SD-05-01 05/27/98 PAI-01-SD-005 0.0 - 0.5'	PAI-01-SD-06-01 05/27/98 PAI-01-SD-006 0.0 - 0.5'	PAI-01-SD-07-01 05/27/98 PAI-01-SD-007 0.0 - 0.5'	PAI-10-SD-016-01 09/09/98 PAI-10-SD-016 0.0 - 0.5'	PAI-10-SD-017-01 09/09/98 PAI-10-SD-017 0.0 - 0.5'	PAI-10-SD-018-01 09/09/98 PAI-10-SD-018 0.0 - 0.5'	/ /
SEMIVOLATILES (µg/kg)							
ACENAPHTHENE	1100 U	100 U	550 U	810 U	1200 U	1000 U	
ACENAPHTHYLENE	570 U	51 U	280 U	810 U	1200 U	1000 U	
ANTHRACENE	23 U	2 U	11 U	810 U	1200 U	1000 U	
BENZO(A)ANTHRACENE	57 U	5.1 U	28 U	810 U	1200 U	1000 U	
BENZO(A)PYRENE	57 U	5.1 U	28 U	810 U	1200 U	1000 U	
BENZO(B)FLUORANTHENE	23 U	2 U	11 U	810 U	1200 U	1000 U	
BENZO(G,H,I)PERYLENE	91 U	8.1 U	44 U	810 U	1200 U	1000 U	
BENZO(K)FLUORANTHENE	23 U	2 U	11 U	810 U	1200 U	1000 U	
BIS(2-CHLOROETHOXY)METHANE	450 U	400 U	440 U	810 U	1200 U	1000 U	
BIS(2-CHLOROETHYL)ETHER	450 U	400 U	440 U	810 U	1200 U	1000 U	
BIS(2-ETHYLHEXYL)PHTHALATE	450 U	400 U	440 U	810 U	150 J	62 J	
BUTYLBENZYL PHTHALATE	450 U	400 U	440 U	810 U	1200 U	1000 U	
CARBAZOLE	450 U	400 U	440 U	810 U	1200 U	1000 U	
CHRYSENE	57 U	5.1 U	28 U	810 U	1200 U	1000 U	
DI-N-BUTYL PHTHALATE	450 U	400 U	440 U	810 U	1200 U	1000 U	
DI-N-OCTYL PHTHALATE	450 U	400 U	440 U	810 U	1200 U	1000 U	
DIBENZO(A,H)ANTHRACENE	230 U	20 U	110 U	810 U	1200 U	1000 U	
DIBENZOFURAN	450 U	400 U	440 U	810 U	1200 U	1000 U	
DIETHYL PHTHALATE	450 U	400 U	440 U	810 U	1200 U	1000 U	
DIMETHYL PHTHALATE	450 U	400 U	440 U	810 U	1200 U	1000 U	
FLUORANTHENE	57 U	5.1 U	28 U	810 U	1200 U	1000 U	
FLUORENE	110 U	10 U	55 U	810 U	1200 U	1000 U	
HEXACHLOROBENZENE	450 U	400 U	440 U	810 U	1200 U	1000 U	
HEXACHLOROBUTADIENE	450 U	400 U	440 U	810 U	1200 U	1000 U	
HEXACHLOROCYCLOPENTADIENE	450 U	400 U	440 U	810 U	1200 U	1000 U	
HEXACHLOROETHANE	450 U	400 U	440 U	810 U	1200 U	1000 U	
INDENO(1,2,3-CD)PYRENE	32 J	3.2 J	14 J	810 U	1200 U	1000 U	
ISOPHORONE	450 U	400 U	440 U	810 U	1200 U	1000 U	
N-NITROSO-DI-N-PROPYLAMINE	450 U	400 U	440 U	810 U	1200 U	1000 U	
N-NITROSODIPHENYLAMINE	450 U	400 U	440 U	810 U	1200 U	1000 U	
NAPHTHALENE	570 U	51 U	280 U	810 U	1200 U	1000 U	

TABLE D-3

PARRIS ISLAND

BACKGROUND SEDIMENT - ANALYTICAL DATABASE

SAMPLE NUMBER:	PAI-01-SD-05-01	PAI-01-SD-06-01	PAI-01-SD-07-01	PAI-10-SD-016-01	PAI-10-SD-017-01	PAI-10-SD-018-01	
COLLECTION DATE:	05/27/98	05/27/98	05/27/98	09/09/98	09/09/98	09/09/98	/ /
LOCATION:	PAI-01-SD-005	PAI-01-SD-006	PAI-01-SD-007	PAI-10-SD-016	PAI-10-SD-017	PAI-10-SD-018	
SAMPLE DEPTH:	0.0 - 0.5'	0.0 - 0.5'	0.0 - 0.5'	0.0 - 0.5'	0.0 - 0.5'	0.0 - 0.5'	
SEMIVOLATILES (µg/kg)							
NITROBENZENE	450 U	400 U	440 U	810 U	1200 U	1000 U	
PENTACHLOROPHENOL	2300 U	2000 U	2200 U	1600 U	2400 U	2100 U	
PHENANTHRENE	46 U	4 U	22 U	810 U	1200 U	1000 U	
PHENOL	450 U	400 U	440 U	810 U	1200 U	1000 U	
PYRENE	110 U	10 U	55 U	810 U	1200 U	1000 U	
PESTICIDES/PCBs (µg/kg)							
4,4'-DDD	22 U	2 U	22 U	8 U	12 U	10 U	
4,4'-DDE	22 U	2 U	22 U	8 U	12 U	10 U	
4,4'-DDT	22 U	2 U	22 U	8 U	12 U	10 U	
ALDRIN	11 U	0.99 U	11 U	4.1 U	6.1 U	5.3 U	
ALPHA-BHC	11 U	0.99 U	11 U	4.1 U	6.1 U	5.3 U	
ALPHA-CHLORDANE	11 U	0.99 U	11 U	4.1 U	6.1 U	5.3 U	
AROCLOR-1016	11 U	9.9 U	11 U	80 U	120 U	100 U	
AROCLOR-1221	11 U	9.9 U	11 U	160 U	240 U	210 U	
AROCLOR-1232	11 U	9.9 U	11 U	80 U	120 U	100 U	
AROCLOR-1242	11 U	9.9 U	11 U	80 U	120 U	100 U	
AROCLOR-1248	11 U	9.9 U	11 U	80 U	120 U	100 U	
AROCLOR-1254	11 U	9.9 U	11 U	80 U	120 U	100 U	
AROCLOR-1260	11 U	9.9 U	11 U	80 U	120 U	100 U	
BETA-BHC	11 U	2.4	11 U	4.1 U	6.1 U	5.3 U	
DELTA-BHC	11 U	0.99 U	11 U	4.1 U	6.1 U	5.3 U	
DIELDRIN	22 U	2 U	22 U	8 U	12 U	10 U	
ENDOSULFAN I	11 U	0.99 U	11 U	4.1 U	6.1 U	5.3 U	
ENDOSULFAN II	22 U	2 U	22 U	8 U	12 U	10 U	
ENDOSULFAN SULFATE	22 U	2 U	22 U	8 U	12 U	10 U	
ENDRIN	22 U	2 U	22 U	8 U	12 U	10 U	
ENDRIN ALDEHYDE	22 U	2 U	22 U	8 U	12 U	10 U	
ENDRIN KETONE	22 U	2 U	22 U	8 U	12 U	10 U	
GAMMA-BHC (LINDANE)	11 U	0.99 U	11 U	4.1 U	6.1 U	5.3 U	
GAMMA-CHLORDANE	11 U	0.99 U	11 U	4.1 U	6.1 U	5.3 U	
HEPTACHLOR	11 U	0.99 U	11 U	4.1 U	6.1 U	5.3 U	

TABLE D-3

PARRIS ISLAND
BACKGROUND SEDIMENT - ANALYTICAL DATABASE

SAMPLE NUMBER:	PAI-01-SD-05-01	PAI-01-SD-06-01	PAI-01-SD-07-01	PAI-10-SD-016-01	PAI-10-SD-017-01	PAI-10-SD-018-01	
COLLECTION DATE:	05/27/98	05/27/98	05/27/98	09/09/98	09/09/98	09/09/98	/ /
LOCATION:	PAI-01-SD-005	PAI-01-SD-006	PAI-01-SD-007	PAI-10-SD-016	PAI-10-SD-017	PAI-10-SD-018	
SAMPLE DEPTH:	0.0 - 0.5'	0.0 - 0.5'	0.0 - 0.5'	0.0 - 0.5'	0.0 - 0.5'	0.0 - 0.5'	
PESTICIDES/PCBs (µg/kg)							
HEPTACHLOR EPOXIDE	11 U	0.99 U	11 U	4.1 U	6.1 U	5.3 U	
METHOXYCHLOR	110 U	9.9 U	110 U	41 U	61 U	53 U	
TOXAPHENE	220 U	20 U	220 U	410 U	610 U	530 U	
INORGANICS (mg/kg)							
ALUMINUM	2370	621	2160	22100	24500	21100	
ANTIMONY	0.19 U	0.17 U	0.19 U	9 U	6.3 U	4.4 U	
ARSENIC	1.4	0.13	0.43	11.6	12.2	10.9	
BARIUM	4.4	1.5	3.5	23.7	26.1	24.7	
BERYLLIUM	0.02 U	0.02 U	0.02 U	0.97	1	0.93	
CADMIUM	0.05 U	0.03 U	0.04 U	0.41 U	0.67 U	0.47 U	
CALCIUM	763	123	1040	1750	2220	6110	
CHROMIUM	4.1	1.3	3.2	32.7	33.6	30.8	
COBALT	0.25	0.06 U	0.27	4.1 U	6.2 U	4.4 U	
COPPER	0.95 U	0.33 U	0.73 U	9.5	10.1	9.8	
CYANIDE	0.62 U	0.53 U	0.61 U	1 U	2 U	8 U	
IRON	2110	411	1430	19800	20700	19900	
LEAD	1.9	1	1.6	18.4 J	22.6 J	16.3 J	
MAGNESIUM	694	259	568	5320	6200	6270	
MANGANESE	22.4	3.1	8.6	128	177	218	
MERCURY	0.02 U	0.03 U	0.02 U	0.07 U	0.1	0.1	
NICKEL	0.58	0.1 U	0.67	10.9 U	11.8 U	10.4 U	
POTASSIUM	389	133	328	2680	3210	2830	
SELENIUM	0.19 U	0.17 U	0.19 U	0.76 U	1.2 U	0.19 U	
SILVER	0.07 U	0.06 U	0.07 U	0.87 U	1.9 U	1.5 U	
SODIUM	2180	1670	2180	13200	20500	17600	
THALLIUM	0.18 U	0.16 U	0.17 U	0.41	0.61 U	0.49 U	
VANADIUM	5.2	1.3	3.9	47	46.6	44.9	
ZINC	3.5	0.63 U	2.9	45.8	42.2	40.2	
MISCELLANEOUS PARAMETERS ()							
ACID VOLATILE SULFIDE (UMOLE/G)				7.9	16	13	
TOTAL ORGANIC CARBON (%)	0.47	0.2	0.23 U	2.8	3	2.7	

TABLE D-4

SELECTION OF SAMPLE LOCATIONS FOR TYPICAL FACILITY PESTICIDE CONCENTRATIONS (1996 AND 1999 TESTING)
MCRD PARIS ISLAND, SOUTH CAROLINA

Site	Discussion[1]	Potential background constituents
Picnic Area Near Site 1	Consists of a picnic area used by base personnel and guests of the facility. The picnic area is located along Malecon Drive approximately 300 feet southeast of Site 1. Historically, pesticides have been applied to the area for insect-control purposes.	Use for pesticides.
5 – Former Paint Shop Disposal Area	Site disposal activities limited to solvents, fuels, and paints (metals). No evidence that pesticides would be disposed at this location. Site is adjacent to Beaufort River.	Use for pesticides.
8 – PCB spill Areas	Insufficient data on site history to indicate potential for waste disposal other than PCBs.	Do not use.
9 – Paint Waste Storage Area	Site activities limited to storage of solvents, fuels, and paints. No evidence of pesticide storage or disposal. Because the site was used for storage, other chemicals may have been stored here.	Do not use.
12 – Jericho Island	Site is being investigated under a RFI/RI. Source of wastes not well defined at this time.	Do not use.
13 – Dredge Spoil Area	Sediments were dredged from area near Marina. Fire training pit was also in the area. The topography in the area has been altered. Samples were collected in the trench around sediments.	Do not use.
14 – Storm Sewer System	Sediments near three storm sewers were evaluated, with samples collected from near the motor pool discharge, the dry cleaner discharge, and the pest control discharge. The motor pool and dry cleaners sites are listed for solvents, battery acid, and x-ray fixer. No evidence of fuel or pesticides activities at these two sites. Because of the site name, do not use storm sewer for pest control.	Use 2 of 3 areas for pesticides.
15 – Potential PCB Area	Oil sprayed roads near Elliott's Beach. Site concern was PCBs.	Use for pesticides.
21 – Weapons Power Plant Oil/Water Separator	Sediments near discharge point were evaluated because of potential concerns with sump within power plant. Sump was later found to discharge to sanitary treatment plant. Trace levels of fuels may have entered discharge point through oil/water separator.	Use for pesticides.

1. Background information obtained from the 1990 RCRA Facility Assessment.

TABLE D-5

TYPICAL FACILITY PESTICIDE CONCENTRATIONS (UG/KG)
MCRD PARRIS ISLAND, SOUTH CAROLINA

Parameter	PI-005-01	PI-005-02	PAI-01-SS-15	PAI-01-SS-16	PI-014-01	PI-014-02	PI-015A-01
4,4'-DDD	11 U	3.7 U	1.7 U	3.4 U	160	19 U	3.8 U
4,4'-DDE	19 J	3.7 U	3.8 J	76 J	18 J	14	9.2 U
4,4'-DDT	42	1.8 J	5.2 J	70 J	24 U	5.2 U	3 J
ALPHA-CHLORDANE	62	1.6 J	0.86 U	1.7 U	11 U	2.6 U	2 U
ENDOSULFAN I	5.7 J	2.8	0.86 U	1.7 U	11 U	2.6 U	2 U
GAMMA-CHLORDANE	58	1.7 J	0.86 U	1.7 U	11 U	2.6 U	2 U
Total DDT/DDE/DDD	66.5	5.5	9.85	147.7	190	26.1	9.5

Parameter	PI-015B-01	PI-021-01	PAI-10-SD-16	PAI-10-SD-17	PAI-10-SD-18	Mean	Typical Facility Pesticide Conc. 2 x Mean
4,4'-DDD	4 U	6.9 U	8 U	12 U	10 U	16.81	33.6
4,4'-DDE	34	6.9 U	8 U	12 U	10 U	15.81	31.6
4,4'-DDT	52	6.9 U	8 U	12 U	10 U	17.25	34.5
ALPHA-CHLORDANE	2.1 U	3.5 U	4.1 U	6.1 U	5.3 U	6.94	13.9
ENDOSULFAN I	2.1 U	3.5 U	4.1 U	6.1 U	5.3 U	2.34	4.7
GAMMA-CHLORDANE	2.1 U	3.5 U	4.1 U	6.1 U	5.3 U	6.61	13.2
Total DDT/DDE/DDD	88	10.35	12	18	15	49.88	99.8

One-half the detection limit was used in mean and Total DDT/DDE/DDD calculations.

APPENDIX E

BAP EQUIVALENTS/TOTAL PAH CALCULATIONS
2001 SEDIMENT SAMPLES

CLIENT: PARRIS ISLAND, SOUTH CAROLINA		JOB NUMBER: 3920 - DRAFT CS	
SUBJECT: SITE 3 - CAUSEWAY LANDFILL			
BASED ON: PAH Data for Sediment from Site 3 CS		DRAWING NUMBER:	
BY: KMS Date: 1/23/02	CHECKED BY: Date:	APPROVED BY:	DATE:

Objective:

Using PAH data for sediment samples collected during the Site 3 CS, calculate Total PAH and BAP Equivalent concentrations.

Assumptions:

(1) Total PAH concentrations will be used to compare against ecological RGOs to determine the extent of impacted sediment.

(2) BAP Equivalent concentrations will be used to compare against the human health RGO to determine the extent of impacted sediment.

(3) Total PAH #1 uses 1/2 the method detection limit (MDL) for nondetects. Laboratory-provided, sample-specific MDLs are used. If an MDL is not available, 1/2 the detection limit is used.

(4) Total PAH #2 assumes a value of zero for nondetects.

(5) For Total PAHs #1 and #2 = Low Molecular Weight PAHs + High Molecular Weight PAHs.

(6) Low Molecular Weight PAHs = 2-methylnaphthalene + acenaphthene + acenaphthylene + anthracene + fluorene + naphthalene + phenanthrene.

(7) High Molecular Weight PAHs = benzo(a)anthracene + benzo(a)pyrene + chyrsene + dibenzo(a,h)anthracene + fluoranthene + pyrene.

(8) Reference for Total PAHs: MacDonald, D.D. 1994. Approach to the Assessment of Sediment Quality in Florida Coastal Waters. FDEP.

(9) BAP equivalents = benzo(a)anthracene(0.1) + benzo(a)pyrene(1.0) + benzo(b)fluoranthene(0.1) + benzo(k)fluoranthene(0.01)
+ chyrsene(0.001) + dibenzo(a,h)anthracene(1.0) + indeno(1,2,3-cd)pyrene (0.1)
For nondetects, 1/2 the method detection limit (MDL) is used.

(10) Bolded cells indicate that an RGO has been exceeded. The following RGOs are used
Human health (soil and sediment) - B(a)P equivalent concentration of 434 ug/kg (MCRD Parris Island derived RGO)
Ecological (soil) - Total PAH concentration of 1000 ug/kg (U.S. EPA Region 4 Screening Value)
Ecological (sediment) - Total PAH concentration of 1684 ug/kg (U.S. EPA Region 4 Screening Value)

Calculations:

PAH Chemicals	Sample PAI-03-SD-41-01 Concentration	Concentration Used	Total PAH #1	Total PAH #2	BAP Equivalent
2-Methylnaphthalene	28 U	28	14	0	
Acenaphthene	28 U	28	14	0	
Acenaphthylene	28 U	28	14	0	
Anthracene	28 U	28	14	0	
Benzo(a)anthracene	24 J	24	24	24	2.4
Benzo(a)pyrene	11 J	11	11	11	11
Benzo(b)fluoranthene	19 J	19	0	0	1.9
Benzo(k)fluoranthene	7 J	7	0	0	0.07
Chrysene	12 J	12	12	12	0.012
Dibenzo(a,h)anthracene	28 U	28	14	0	14
Fluoranthene	42 J	42	42	42	
Fluorene	28 U	28	14	0	
Indeno(1,2,3-cd)pyrene	28 U	28	0	0	1.4
Naphthalene	28 U	28	14	0	
Phenanthrene	7 J	7	7	7	
Pyrene	22 J	22	22	22	
	SUM		216	118	31

PAH Chemicals	Sample PAI-03-SD-41-01-D Concentration	Concentration Used	Total PAH #1	Total PAH #2	BAP Equivalent
2-Methylnaphthalene	28 U	28	14	0	
Acenaphthene	28 J	28	28	28	
Acenaphthylene	28 U	28	14	0	
Anthracene	78 J	78	78	78	
Benzo(a)anthracene	300 J	300	300	300	30
Benzo(a)pyrene	170 J	170	170	170	170
Benzo(b)fluoranthene	230 J	230	0	0	23
Benzo(k)fluoranthene	82 J	82	0	0	0.82
Chrysene	190 J	190	190	190	0.19
Dibenzo(a,h)anthracene	26 J	26	26	26	26
Fluoranthene	470 J	470	470	470	
Fluorene	37	37	37	37	
Indeno(1,2,3-cd)pyrene	120 J	120	0	0	12
Naphthalene	28 U	28	14	0	
Phenanthrene	320 J	320	320	320	
Pyrene	330 J	330	330	330	
	SUM		**1991**	**1949**	262

CLIENT: PARRIS ISLAND, SOUTH CAROLINA		JOB NUMBER: 3920 - DRAFT CS	
SUBJECT: SITE 3 - CAUSEWAY LANDFILL			
BASED ON: PAH Data for Sediment from Site 3 CS		DRAWING NUMBER:	
BY: KMS Date: 1/23/02	CHECKED BY: Date:	APPROVED BY:	DATE:

PAH Chemicals	Sample PAI-03-SD-41-AVG Concentration	Concentration Used	Total PAH #1	Total PAH #2	BAP Equivalent
2-Methylnaphthalene	28 U	28	14	0	
Acenaphthene	28 J	28	28	28	
Acenaphthylene	28 U	28	14	0	
Anthracene	46 J	46	46	46	
Benzo(a)anthracene	162 J	162	162	162	16.2
Benzo(a)pyrene	90.5 J	90.5	91	90.5	90.5
Benzo(b)fluoranthene	124.5 J	124.5	0	0	12.45
Benzo(k)fluoranthene	44.5 J	44.5	0	0	0.445
Chrysene	101 J	101	101	101	0.101
Dibenzo(a,h)anthracene	26 J	26	26	26	26
Fluoranthene	256 J	256	256	256	
Fluorene	25.5	25.5	26	25.5	
Indeno(1,2,3-cd)pyrene	67 J	67	0	0	6.7
Naphthalene	28 U	28	14	0	
Phenanthrene	163.5 J	163.5	164	163.5	
Pyrene	176 J	176	176	176	
	SUM		1117	1075	152

PAH Chemicals	Sample PAI-03-SD-42-01 Concentration	Concentration Used	Total PAH #1	Total PAH #2	BAP Equivalent
2-Methylnaphthalene	26 U	26	13	0	
Acenaphthene	26 U	26	13	0	
Acenaphthylene	26 U	26	13	0	
Anthracene	26 U	26	13	0	
Benzo(a)anthracene	66	66	66	66	6.6
Benzo(a)pyrene	48	48	48	48	48
Benzo(b)fluoranthene	59	59	0	0	5.9
Benzo(k)fluoranthene	24 J	24	0	0	0.24
Chrysene	34	34	34	34	0.034
Dibenzo(a,h)anthracene	12 J	12	12	12	12
Fluoranthene	91	91	91	91	
Fluorene	26 U	26	13	0	
Indeno(1,2,3-cd)pyrene	46	46	0	0	4.6
Naphthalene	26 U	26	13	0	
Phenanthrene	23 J	23	23	23	
Pyrene	53	53	53	53	
	SUM		405	327	77

PAH Chemicals	Sample PAI-03-SD-43-01 Concentration	Concentration Used	Total PAH #1	Total PAH #2	BAP Equivalent
2-Methylnaphthalene	70 U	70	35	0	
Acenaphthene	70 U	70	35	0	
Acenaphthylene	70 U	70	35	0	
Anthracene	70 U	70	35	0	
Benzo(a)anthracene	29 J	29	29	29	2.9
Benzo(a)pyrene	70 U	70	35	0	35
Benzo(b)fluoranthene	25 J	25	0	0	2.5
Benzo(k)fluoranthene	70 U	70	0	0	0.35
Chrysene	70 U	70	35	0	0.035
Dibenzo(a,h)anthracene	70 U	70	35	0	35
Fluoranthene	34 J	34	34	34	
Fluorene	70 U	70	35	0	
Indeno(1,2,3-cd)pyrene	70 U	70	0	0	3.5
Naphthalene	70 U	70	35	0	
Phenanthrene	70 U	70	35	0	
Pyrene	21 J	21	21	21	
	SUM		434	84	79

CLIENT: PARRIS ISLAND, SOUTH CAROLINA		JOB NUMBER: 3920 - DRAFT CS	
SUBJECT: SITE 3 - CAUSEWAY LANDFILL			
BASED ON: PAH Data for Sediment from Site 3 CS		DRAWING NUMBER:	
BY: KMS Date: 1/23/02	CHECKED BY: Date:	APPROVED BY:	DATE:

PAH Chemicals	Sample PAI-03-SD-44-01 Concentration	Concentration Used	Total PAH #1	Total PAH #2	BAP Equivalent
2-Methylnaphthalene	56 U	56	28	0	
Acenaphthene	56 U	56	28	0	
Acenaphthylene	56 U	56	28	0	
Anthracene	56 U	56	28	0	
Benzo(a)anthracene	12 J	12	12	12	1.2
Benzo(a)pyrene	56 U	56	28	0	28
Benzo(b)fluoranthene	13 J	13	0	0	1.3
Benzo(k)fluoranthene	56 U	56	0	0	0.28
Chrysene	56 U	56	28	0	0.028
Dibenzo(a,h)anthracene	56 U	56	28	0	28
Fluoranthene	21 J	21	21	21	
Fluorene	56 U	56	28	0	
Indeno(1,2,3-cd)pyrene	56 U	56	0	0	2.8
Naphthalene	56 U	56	28	0	
Phenanthrene	56 U	56	28	0	
Pyrene	12 J	12	12	12	
	SUM		325	45	62

PAH Chemicals	Sample PAI-03-SD-45-01 Concentration	Concentration Used	Total PAH #1	Total PAH #2	BAP Equivalent
2-Methylnaphthalene	42 U	42	21	0	
Acenaphthene	42 U	42	21	0	
Acenaphthylene	42 U	42	21	0	
Anthracene	42 U	42	21	0	
Benzo(a)anthracene	30 J	30	30	30	3
Benzo(a)pyrene	14 J	14	14	14	14
Benzo(b)fluoranthene	25 J	25	0	0	2.5
Benzo(k)fluoranthene	42 U	42	0	0	0.21
Chrysene	17 J	17	17	17	0.017
Dibenzo(a,h)anthracene	42 U	42	21	0	21
Fluoranthene	58 J	58	58	58	
Fluorene	42 U	42	21	0	
Indeno(1,2,3-cd)pyrene	42 U	42	0	0	2.1
Naphthalene	42 U	42	21	0	
Phenanthrene	23 J	23	23	23	
Pyrene	33 J	33	33	33	
	SUM		322	175	43

PAH Chemicals	Sample PAI-03-SD-45-01-D Concentration	Concentration Used	Total PAH #1	Total PAH #2	BAP Equivalent
2-Methylnaphthalene	42 U	42	21	0	
Acenaphthene	42 U	42	21	0	
Acenaphthylene	42 U	42	21	0	
Anthracene	14 J	14	14	14	
Benzo(a)anthracene	67	67	67	67	6.7
Benzo(a)pyrene	30 J	30	30	30	30
Benzo(b)fluoranthene	45	45	0	0	4.5
Benzo(k)fluoranthene	14 J	14	0	0	0.14
Chrysene	31 J	31	31	31	0.031
Dibenzo(a,h)anthracene	42 U	42	21	0	21
Fluoranthene	120	120	120	120	
Fluorene	8 J	8	8	8	
Indeno(1,2,3-cd)pyrene	18 J	18	0	0	1.8
Naphthalene	42 U	42	21	0	
Phenanthrene	86	86	86	86	
Pyrene	57	57	57	57	
	SUM		518	413	64

CLIENT: PARRIS ISLAND, SOUTH CAROLINA		JOB NUMBER: 3920 - DRAFT CS
SUBJECT: SITE 3 - CAUSEWAY LANDFILL		
BASED ON: PAH Data for Sediment from Site 3 CS		DRAWING NUMBER:
BY: KMS Date: 1/23/02	CHECKED BY: Date:	APPROVED BY: DATE:

PAH Chemicals	Sample PAI-03-SD-45-01-AVG Concentration	Concentration Used	Total PAH #1	Total PAH #2	BAP Equivalent
2-Methylnaphthalene	42 U	42	21	0	
Acenaphthene	42 U	42	21	0	
Acenaphthylene	42 U	42	21	0	
Anthracene	14 J	14	14	14	
Benzo(a)anthracene	48.5 J	48.5	49	48.5	4.85
Benzo(a)pyrene	22 J	22	22	22	22
Benzo(b)fluoranthene	35 J	35	0	0	3.5
Benzo(k)fluoranthene	14 J	14	0	0	0.14
Chrysene	24 J	24	24	24	0.024
Dibenzo(a,h)anthracene	42 U	42	21	0	21
Fluoranthene	89 J	89	89	89	
Fluorene	8 J	8	8	8	
Indeno(1,2,3-cd)pyrene	18 J	18	0	0	1.8
Naphthalene	42 U	42	21	0	
Phenanthrene	54.5 J	54.5	55	54.5	
Pyrene	45 J	45	45	45	
	SUM		410	305	53

PAH Chemicals	Sample PAI-03-SD-46-01 Concentration	Concentration Used	Total PAH #1	Total PAH #2	BAP Equivalent
2-Methylnaphthalene	28 U	28	14	0	
Acenaphthene	28 U	28	14	0	
Acenaphthylene	28 U	28	14	0	
Anthracene	28 U	28	14	0	
Benzo(a)anthracene	28 U	28	14	0	1.4
Benzo(a)pyrene	28 U	28	14	0	14
Benzo(b)fluoranthene	28 U	28	0	0	1.4
Benzo(k)fluoranthene	28 U	28	0	0	0.14
Chrysene	28 U	28	14	0	0.014
Dibenzo(a,h)anthracene	28 U	28	14	0	14
Fluoranthene	28 U	28	14	0	
Fluorene	28 U	28	14	0	
Indeno(1,2,3-cd)pyrene	28 U	28	0	0	1.4
Naphthalene	28 U	28	14	0	
Phenanthrene	28 U	28	14	0	
Pyrene	28 U	28	14	0	
	SUM		182	0	32

PAH Chemicals	Sample PAI-03-SD-47-01 Concentration	Concentration Used	Total PAH #1	Total PAH #2	BAP Equivalent
2-Methylnaphthalene	50 U	50	25	0	
Acenaphthene	50 U	50	25	0	
Acenaphthylene	50 U	50	25	0	
Anthracene	50 U	50	25	0	
Benzo(a)anthracene	18 J	18	18	18	1.8
Benzo(a)pyrene	50 U	50	25	0	25
Benzo(b)fluoranthene	15 J	15	0	0	1.5
Benzo(k)fluoranthene	50 U	50	0	0	0.25
Chrysene	11 J	11	11	11	0.011
Dibenzo(a,h)anthracene	50 U	50	25	0	25
Fluoranthene	25 J	25	25	25	
Fluorene	50 U	50	25	0	
Indeno(1,2,3-cd)pyrene	50 U	50	0	0	2.5
Naphthalene	50 U	50	25	0	
Phenanthrene	50 U	50	25	0	
Pyrene	17 J	17	17	17	
	SUM		296	71	56

CLIENT: PARRIS ISLAND, SOUTH CAROLINA		JOB NUMBER: 3920 - DRAFT CS
SUBJECT: SITE 3 - CAUSEWAY LANDFILL		
BASED ON: PAH Data for Sediment from Site 3 CS		DRAWING NUMBER:
BY: KMS Date: 1/23/02	CHECKED BY: Date:	APPROVED BY: DATE:

PAH Chemicals	Sample PAI-03-SD-48-01 Concentration	Concentration Used	Total PAH #1	Total PAH #2	BAP Equivalent
2-Methylnaphthalene	34 U	34	17	0	
Acenaphthene	34 U	34	17	0	
Acenaphthylene	34 U	34	17	0	
Anthracene	34 U	34	17	0	
Benzo(a)anthracene	13 J	13	13	13	1.3
Benzo(a)pyrene	34 U	34	17	0	17
Benzo(b)fluoranthene	10 J	10	0	0	1
Benzo(k)fluoranthene	34 U	34	0	0	0.17
Chrysene	9 J	9	9	9	0.009
Dibenzo(a,h)anthracene	34 U	34	17	0	17
Fluoranthene	28 J	28	28	28	
Fluorene	34 U	34	17	0	
Indeno(1,2,3-cd)pyrene	34 U	34	0	0	1.7
Naphthalene	34 U	34	17	0	
Phenanthrene	10 J	10	10	10	
Pyrene	17 J	17	17	17	
	SUM		213	77	38

PAH Chemicals	Sample PAI-03-SD-49-01 Concentration	Concentration Used	Total PAH #1	Total PAH #2	BAP Equivalent
2-Methylnaphthalene	28 U	28	14	0	
Acenaphthene	28 U	28	14	0	
Acenaphthylene	28 U	28	14	0	
Anthracene	28 U	28	14	0	
Benzo(a)anthracene	13 J	13	13	13	1.3
Benzo(a)pyrene	28 U	28	14	0	14
Benzo(b)fluoranthene	10 J	10	0	0	1
Benzo(k)fluoranthene	28 U	28	0	0	0.14
Chrysene	6 J	6	6	6	0.006
Dibenzo(a,h)anthracene	28 U	28	14	0	14
Fluoranthene	27 J	27	27	27	
Fluorene	28 U	28	14	0	
Indeno(1,2,3-cd)pyrene	28 U	28	0	0	1.4
Naphthalene	340 U	340	170	0	
Phenanthrene	12 J	12	12	12	
Pyrene	14 J	14	14	14	
	SUM		340	72	32

Conclusions

The following samples exceeded ecological screening criterion

Sample ID	Matrix	Total PAH Conc.	Criterion	Notes
PAI-03-SD-41-D	Sediment	1991	1684	PAHs were not detected in PAI-03-SD-41 or PAI-03-SD-41-AVG above criterion.

The following samples exceeded human health screening criterion

Sample ID	Matrix	B(a)P Eq. Conc.	Criterion	Notes
None	Sediment	None	434	No exceedances.

APPENDIX F

CALCULATION OF AVERAGE CONCENTRATIONS

F-1 2001 RESULTS

F-2 1998 RESULTS

F-1 2001 RESULTS

CLIENT: PARRIS ISLAND, SOUTH CAROLINA		JOB NUMBER: 3920 - DRAFT CS
SUBJECT: SITE 3 - CAUSEWAY LANDFILL		
BASED ON: CALCULATION OF PESTICIDE/PCB AVERAGES AND MAXIMUMS		DRAWING NUMBER:
BY: KMS Date: 2/5/02	CHECKED BY: Date:	APPROVED BY: DATE:

Objective:

Since laboratory reported PQL's and CRQL's exceed effects level ecological screening values, use laboratory method detection limits for pesticide and PCB calculations for sediment samples collected during the Site 3 CS.

Assumptions:

(1) Katahdin Analytical Services, Inc. soil MDLs will be used to calculate detection limits for Pesticides and PCBs which were not detected in sediment.

(2) If a pesticide or PCB is not detected (ND), 1/2 the laboratory MDL, adjusting for moisture, will be used.
Sample MDL = MDL / Percent Solids in Sample

(3) Site 3 will be broken up into five areas for the calculations.

(4) To calculate the average concentration of a pesticide or PCB for a duplicate sample, the average of the original and duplicate sample will be used.

Calculations:

Marsh Side (samples PAI-03-SD-41 through PAI-03-SD-45)

PESTICIDE/PCB Chemicals	Sample PAI-03-SD-41-01 Concentration (ug/kg)	Laboratory MDL	% Solids	Sample MDL	Concentration Used (1)	
4,4'-DDD	3.8 J	0.603	70.0	0.9	3.8	J
4,4'-DDE	1.8 J	0.302	70.0	0.4	1.8	J
4,4'-DDT	12 J	0.546	70.0	0.8	12.0	J
Alpha-chlordane	2.4 U	0.36	70.0	0.5	0.3	U
Aroclor-1016	24 U	4.24	70.0	6.1	3.0	U
Aroclor-1221	24 U	2.96	70.0	4.2	2.1	U
Aroclor-1232	24 U	4.19	70.0	6.0	3.0	U
Aroclor-1242	24 U	5.34	70.0	7.6	3.8	U
Aroclor-1248	24 U	3.16	70.0	4.5	2.3	U
Aroclor-1254	24 U	3.95	70.0	5.6	2.8	U
Aroclor-1260	24 U	3.69	70.0	5.3	2.6	U
Gamma-chlordane	2.4 U	0.88	70.0	1.3	0.6	U

PESTICIDE/PCB Chemicals	Sample PAI-03-SD-41-01-D Concentration (ug/kg)	Laboratory MDL	% Solids	Sample MDL	Concentration Used (1)	
4,4'-DDD	2.8 J	0.603	71.0	0.8	2.8	J
4,4'-DDE	1.4 J	0.302	71.0	0.4	1.4	J
4,4'-DDT	1.1 J	0.546	71.0	0.8	1.1	J
Alpha-chlordane	2.4 U	0.36	71.0	0.5	0.3	U
Aroclor-1016	24 U	4.24	71.0	6.0	3.0	U
Aroclor-1221	24 U	2.96	71.0	4.2	2.1	U
Aroclor-1232	24 U	4.19	71.0	5.9	3.0	U
Aroclor-1242	24 U	5.34	71.0	7.5	3.8	U
Aroclor-1248	24 U	3.16	71.0	4.5	2.2	U
Aroclor-1254	24 U	3.95	71.0	5.6	2.8	U
Aroclor-1260	24 U	3.69	71.0	5.2	2.6	U
Gamma-chlordane	2.4 U	0.88	71.0	1.2	0.6	U

PESTICIDE/PCB Chemicals	Sample PAI-03-SD-41-AVG Concentration (ug/kg)	Laboratory MDL	% Solids	Sample MDL	Concentration Used (1)	
4,4'-DDD	3.3 J	0.603	70.5	0.9	3.3	J
4,4'-DDE	1.6 J	0.302	70.5	0.4	1.6	J
4,4'-DDT	6.55 J	0.546	70.5	0.8	6.6	J
Alpha-chlordane	2.4 U	0.36	70.5	0.5	0.3	U
Aroclor-1016	24 U	4.24	70.5	6.0	3.0	U
Aroclor-1221	24 U	2.96	70.5	4.2	2.1	U
Aroclor-1232	24 U	4.19	70.5	5.9	3.0	U
Aroclor-1242	24 U	5.34	70.5	7.6	3.8	U
Aroclor-1248	24 U	3.16	70.5	4.5	2.2	U
Aroclor-1254	24 U	3.95	70.5	5.6	2.8	U
Aroclor-1260	24 U	3.69	70.5	5.2	2.6	U
Gamma-chlordane	2.4 U	0.88	70.5	1.3	0.6	U

CLIENT: PARRIS ISLAND, SOUTH CAROLINA		JOB NUMBER: 3920 - DRAFT CS	
SUBJECT: SITE 3 - CAUSEWAY LANDFILL			
BASED ON: CALCULATION OF PESTICIDE/PCB AVERAGES AND MAXIMUMS		DRAWING NUMBER:	
BY: KMS Date: 2/5/02	CHECKED BY: Date:	APPROVED BY:	DATE:

PESTICIDE/PCB Chemicals	Sample PAI-03-SD-42-01 Concentration (ug/kg)	Laboratory MDL	% Solids	Sample MDL	Concentration Used (1)	
4,4'-DDD	1.4 J	0.603	76.0	0.8	1.4	J
4,4'-DDE	1.5 J	0.302	76.0	0.4	1.5	J
4,4'-DDT	1.5 J	0.546	76.0	0.7	1.5	J
Alpha-chlordane	6.6	0.36	76.0	0.5	6.6	
Aroclor-1016	22 U	4.24	76.0	5.6	2.8	U
Aroclor-1221	22 U	2.96	76.0	3.9	1.9	U
Aroclor-1232	22 U	4.19	76.0	5.5	2.8	U
Aroclor-1242	22 U	5.34	76.0	7.0	3.5	U
Aroclor-1248	22 U	3.16	76.0	4.2	2.1	U
Aroclor-1254	22 U	3.95	76.0	5.2	2.6	U
Aroclor-1260	22 U	3.69	76.0	4.9	2.4	U
Gamma-chlordane	2.2 U	0.88	76.0	1.2	0.6	U

PESTICIDE/PCB Chemicals	Sample PAI-03-SD-43-01 Concentration (ug/kg)	Laboratory MDL	% Solids	Sample MDL	Concentration Used (1)	
4,4'-DDD	12 UJ	0.603	28.0	2.2	1.1	UJ
4,4'-DDE	2.9 J	0.302	28.0	1.1	2.9	J
4,4'-DDT	12 UJ	0.546	28.0	2.0	1.0	UJ
Alpha-chlordane	6.0 UJ	0.36	28.0	1.3	0.6	UJ
Aroclor-1016	60 UJ	4.24	28.0	15.1	7.6	UJ
Aroclor-1221	60 UJ	2.96	28.0	10.6	5.3	UJ
Aroclor-1232	60 UJ	4.19	28.0	15.0	7.5	UJ
Aroclor-1242	60 UJ	5.34	28.0	19.1	9.5	UJ
Aroclor-1248	60 UJ	3.16	28.0	11.3	5.6	UJ
Aroclor-1254	60 UJ	3.95	28.0	14.1	7.1	UJ
Aroclor-1260	60 UJ	3.69	28.0	13.2	6.6	UJ
Gamma-chlordane	6.0 UJ	0.88	28.0	3.2	1.6	UJ

PESTICIDE/PCB Chemicals	Sample PAI-03-SD-44-01 Concentration (ug/kg)	Laboratory MDL	% Solids	Sample MDL	Concentration Used (1)	
4,4'-DDD	9.2 U	0.603	36.0	1.7	0.8	U
4,4'-DDE	1.7 J	0.302	36.0	0.8	1.7	J
4,4'-DDT	9.2 U	0.546	36.0	1.5	0.8	U
Alpha-chlordane	4.7 U	0.36	36.0	1.0	0.5	U
Aroclor-1016	47 U	4.24	36.0	11.8	5.9	U
Aroclor-1221	47 U	2.96	36.0	8.2	4.1	U
Aroclor-1232	47 U	4.19	36.0	11.6	5.8	U
Aroclor-1242	47 U	5.34	36.0	14.8	7.4	U
Aroclor-1248	47 U	3.16	36.0	8.8	4.4	U
Aroclor-1254	47 U	3.95	36.0	11.0	5.5	U
Aroclor-1260	47 U	3.69	36.0	10.3	5.1	U
Gamma-chlordane	4.7 U	0.88	36.0	2.5	1.2	U

PESTICIDE/PCB Chemicals	Sample PAI-03-SD-45-01 Concentration (ug/kg)	Laboratory MDL	% Solids	Sample MDL	Concentration Used (1)	
4,4'-DDD	7.1 U	0.603	47.0	1.3	0.6	U
4,4'-DDE	1.6 J	0.302	47.0	0.6	1.6	J
4,4'-DDT	7.1 U	0.546	47.0	1.2	0.6	U
Alpha-chlordane	3.6 U	0.36	47.0	0.8	0.4	U
Aroclor-1016	36 U	4.24	47.0	9.0	4.5	U
Aroclor-1221	36 U	2.96	47.0	6.3	3.1	U
Aroclor-1232	36 U	4.19	47.0	8.9	4.5	U
Aroclor-1242	36 U	5.34	47.0	11.4	5.7	U
Aroclor-1248	36 U	3.16	47.0	6.7	3.4	U
Aroclor-1254	36 U	3.95	47.0	8.4	4.2	U
Aroclor-1260	36 U	3.69	47.0	7.9	3.9	U
Gamma-chlordane	3.6 U	0.88	47.0	1.9	0.9	U

CLIENT: PARRIS ISLAND, SOUTH CAROLINA			JOB NUMBER: 3920 - DRAFT CS	
SUBJECT: SITE 3 - CAUSEWAY LANDFILL				
BASED ON: CALCULATION OF PESTICIDE/PCB AVERAGES AND MAXIMUMS			DRAWING NUMBER:	
BY: KMS		CHECKED BY:	APPROVED BY:	DATE:
Date: 2/5/02		Date:		

PESTICIDE/PCB Chemicals	Sample PAI-03-SD-45-01-D Concentration (ug/kg)	Laboratory MDL	% Solids	Sample MDL	Concentration Used (1)	
4,4'-DDD	7.0 U	0.603	47.0	1.3	0.6	U
4,4'-DDE	1.7 J	0.302	47.0	0.6	1.7	J
4,4'-DDT	7.0 U	0.546	47.0	1.2	0.6	U
Alpha-chlordane	3.6 U	0.36	47.0	0.8	0.4	U
Aroclor-1016	36 U	4.24	47.0	9.0	4.5	U
Aroclor-1221	36 U	2.96	47.0	6.3	3.1	U
Aroclor-1232	36 U	4.19	47.0	8.9	4.5	U
Aroclor-1242	36 U	5.34	47.0	11.4	5.7	U
Aroclor-1248	36 U	3.16	47.0	6.7	3.4	U
Aroclor-1254	36 U	3.95	47.0	8.4	4.2	U
Aroclor-1260	36 U	3.69	47.0	7.9	3.9	U
Gamma-chlordane	3.6 U	0.88	47.0	1.9	0.9	U

PESTICIDE/PCB Chemicals	Sample PAI-03-SD-45-01-AVG Concentration (ug/kg)	Laboratory MDL	% Solids	Sample MDL	Concentration Used (1)	
4,4'-DDD	7.05 U	0.603	47.0	1.3	0.6	U
4,4'-DDE	1.65 J	0.302	47.0	0.6	1.7	J
4,4'-DDT	7.05 U	0.546	47.0	1.2	0.6	U
Alpha-chlordane	3.6 U	0.36	47.0	0.8	0.4	U
Aroclor-1016	36 U	4.24	47.0	9.0	4.5	U
Aroclor-1221	36 U	2.96	47.0	6.3	3.1	U
Aroclor-1232	36 U	4.19	47.0	8.9	4.5	U
Aroclor-1242	36 U	5.34	47.0	11.4	5.7	U
Aroclor-1248	36 U	3.16	47.0	6.7	3.4	U
Aroclor-1254	36 U	3.95	47.0	8.4	4.2	U
Aroclor-1260	36 U	3.69	47.0	7.9	3.9	U
Gamma-chlordane	3.6 U	0.88	47.0	1.9	0.9	U

PESTICIDE/PCB Chemicals	Avg (ug/kg)	MARSH SIDE Max (ug/kg)	Max Location
4,4'-DDD	1.5	3.8	PAI-03-SD-41-01
4,4'-DDE	1.9	2.9	PAI-03-SD-43-01
4,4'-DDT	2.1	12.0	PAI-03-SD-41-01
Alpha-chlordane	1.7	6.6	PAI-03-SD-42-01
Aroclor-1016	NA	ND (7.6)	PAI-03-SD-43-01
Aroclor-1221	NA	ND (5.3)	PAI-03-SD-43-01
Aroclor-1232	NA	ND (7.5)	PAI-03-SD-43-01
Aroclor-1242	NA	ND (9.5)	PAI-03-SD-43-01
Aroclor-1248	NA	ND (5.6)	PAI-03-SD-43-01
Aroclor-1254	NA	ND (7.1)	PAI-03-SD-43-01
Aroclor-1260	NA	ND (6.6)	PAI-03-SD-43-01
Gamma-chlordane	NA	ND (1.6)	PAI-03-SD-43-01

Notes:

(1) This value was used to calculate the mean concentration for the samples.

NA : Not applicable because all samples in the area did not detect this chemical.

ND: Not dectected at the concentration in paranthesis.

CLIENT: PARRIS ISLAND, SOUTH CAROLINA		JOB NUMBER: 3920 - DRAFT CS	
SUBJECT: SITE 3 - CAUSEWAY LANDFILL			
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BY: KMS Date: 2/5/02	CHECKED BY: Date:	APPROVED BY:	DATE:

Hot Spot 1 - Pond Side (samples PAI-03-SD-46 through PAI-03-SD-49)

The samples in this area were not analyzed for Pesticides or PCBs.

CLIENT: PARRIS ISLAND, SOUTH CAROLINA		JOB NUMBER: 3920 - DRAFT CS
SUBJECT: SITE 3 - CAUSEWAY LANDFILL		
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BY: KMS Date: 2/5/02	CHECKED BY: Date:	APPROVED BY: DATE:

Hot Spot 2 - Pond Side (samples PAI-03-SD-50 through PAI-03-SD-52)

PESTICIDE/PCB Chemicals	Sample PAI-03-SD-50-01 Concentration (ug/kg)	Laboratory MDL	% Solids	Sample MDL	Concentration Used (1)	
4,4'-DDD	Not Analyzed				Not Analyzed	
4,4'-DDE	Not Analyzed				Not Analyzed	
4,4'-DDT	Not Analyzed				Not Analyzed	
Alpha-chlordane	Not Analyzed				Not Analyzed	
Aroclor-1016	47 U	4.24	36.0	11.8	5.9	U
Aroclor-1221	47 U	2.96	36.0	8.2	4.1	U
Aroclor-1232	47 U	4.19	36.0	11.6	5.8	U
Aroclor-1242	47 U	5.34	36.0	14.8	7.4	U
Aroclor-1248	47 U	3.16	36.0	8.8	4.4	U
Aroclor-1254	47 U	3.95	36.0	11.0	5.5	U
Aroclor-1260	47 U	3.69	36.0	10.3	5.1	U
Gamma-chlordane	Not Analyzed				Not Analyzed	

PESTICIDE/PCB Chemicals	Sample PAI-03-SD-51-01 Concentration (ug/kg)	Laboratory MDL	% Solids	Sample MDL	Concentration Used (1)	
4,4'-DDD	Not Analyzed				Not Analyzed	
4,4'-DDE	Not Analyzed				Not Analyzed	
4,4'-DDT	Not Analyzed				Not Analyzed	
Alpha-chlordane	Not Analyzed				Not Analyzed	
Aroclor-1016	33 U	4.24	51.0	8.3	4.2	U
Aroclor-1221	33 U	2.96	51.0	5.8	2.9	U
Aroclor-1232	33 U	4.19	51.0	8.2	4.1	U
Aroclor-1242	33 U	5.34	51.0	10.5	5.2	U
Aroclor-1248	33 U	3.16	51.0	6.2	3.1	U
Aroclor-1254	33 U	3.95	51.0	7.7	3.9	U
Aroclor-1260	33 U	3.69	51.0	7.2	3.6	U
Gamma-chlordane	Not Analyzed				Not Analyzed	

PESTICIDE/PCB Chemicals	Sample PAI-03-SD-52-01 Concentration (ug/kg)	Laboratory MDL	% Solids	Sample MDL	Concentration Used (1)	
4,4'-DDD	Not Analyzed				Not Analyzed	
4,4'-DDE	Not Analyzed				Not Analyzed	
4,4'-DDT	Not Analyzed				Not Analyzed	
Alpha-chlordane	Not Analyzed				Not Analyzed	
Aroclor-1016	44 U	4.24	39.0	10.9	5.4	U
Aroclor-1221	44 U	2.96	39.0	7.6	3.8	U
Aroclor-1232	44 U	4.19	39.0	10.7	5.4	U
Aroclor-1242	44 U	5.34	39.0	13.7	6.8	U
Aroclor-1248	44 U	3.16	39.0	8.1	4.1	U
Aroclor-1254	44 U	3.95	39.0	10.1	5.1	U
Aroclor-1260	44 U	3.69	39.0	9.5	4.7	U
Gamma-chlordane	Not Analyzed				Not Analyzed	

PESTICIDE/PCB Chemicals	Avg (ug/kg)	Hot Spot 2 Max (ug/kg)	Max Location
4,4'-DDD	Not Analyzed	-	-
4,4'-DDE	Not Analyzed	-	-
4,4'-DDT	Not Analyzed	-	-
Alpha-chlordane	Not Analyzed	-	-
Aroclor-1016	NA	ND (5.9)	PAI-03-SD-50-01
Aroclor-1221	NA	ND (4.1)	PAI-03-SD-50-01
Aroclor-1232	NA	ND (5.8)	PAI-03-SD-50-01
Aroclor-1242	NA	ND (7.4)	PAI-03-SD-50-01
Aroclor-1248	NA	ND (4.4)	PAI-03-SD-50-01
Aroclor-1254	NA	ND (5.5)	PAI-03-SD-50-01
Aroclor-1260	NA	ND (5.1)	PAI-03-SD-50-01
Gamma-chlordane	Not Analyzed	-	-

Notes:
(1) This value was used to calculate the mean concentration for the samples.

NA : Not applicable because all samples in the area did not detect this chemical.

ND: Not dectected at the concentration in paranthesis.

Not Analyzed: The sample was not analyzed for this chemical.

CLIENT: PARRIS ISLAND, SOUTH CAROLINA		JOB NUMBER: 3920 - DRAFT CS	
SUBJECT: SITE 3 - CAUSEWAY LANDFILL			
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Hot Spot 3 - Pond Side (samples PAI-03-SD-53 through PAI-03-SD-55)

PESTICIDE/PCB Chemicals	Sample PAI-03-SD-53-01 Concentration (ug/kg)	Laboratory MDL	% Solids	Sample MDL	Concentration Used (1)	
4,4'-DDD	5.7 U	0.603	58.0	1.0	0.5	U
4,4'-DDE	5.7 U	0.302	58.0	0.5	0.3	U
4,4'-DDT	5.7 U	0.546	58.0	0.9	0.5	U
Alpha-chlordane	2.9 U	0.36	58.0	0.6	0.3	U
Aroclor-1016	Not Analyzed				Not Analyzed	
Aroclor-1221	Not Analyzed				Not Analyzed	
Aroclor-1232	Not Analyzed				Not Analyzed	
Aroclor-1242	Not Analyzed				Not Analyzed	
Aroclor-1248	Not Analyzed				Not Analyzed	
Aroclor-1254	Not Analyzed				Not Analyzed	
Aroclor-1260	Not Analyzed				Not Analyzed	
Gamma-chlordane	2.9 U	0.88	58.0	1.5	0.8	U

PESTICIDE/PCB Chemicals	Sample PAI-03-SD-54-01 Concentration (ug/kg)	Laboratory MDL	% Solids	Sample MDL	Concentration Used (1)	
4,4'-DDD	5.5 U	0.603	73.0	0.8	0.4	U
4,4'-DDE	1.2 J	0.302	73.0	0.4	1.2	J
4,4'-DDT	5.5 U	0.546	73.0	0.7	0.4	U
Alpha-chlordane	2.8 U	0.36	73.0	0.5	0.2	U
Aroclor-1016	Not Analyzed				Not Analyzed	
Aroclor-1221	Not Analyzed				Not Analyzed	
Aroclor-1232	Not Analyzed				Not Analyzed	
Aroclor-1242	Not Analyzed				Not Analyzed	
Aroclor-1248	Not Analyzed				Not Analyzed	
Aroclor-1254	Not Analyzed				Not Analyzed	
Aroclor-1260	Not Analyzed				Not Analyzed	
Gamma-chlordane	3.4	0.88	73.0	1.2	3.4	

PESTICIDE/PCB Chemicals	Sample PAI-03-SD-55-01 Concentration (ug/kg)	Laboratory MDL	% Solids	Sample MDL	Concentration Used (1)	
4,4'-DDD	2.7 J	0.603	54.0	1.1	2.7	J
4,4'-DDE	1.7 J	0.302	54.0	0.6	1.7	J
4,4'-DDT	1.3 J	0.546	54.0	1.0	1.3	J
Alpha-chlordane	3.2 U	0.36	54.0	0.7	0.3	U
Aroclor-1016	Not Analyzed				Not Analyzed	
Aroclor-1221	Not Analyzed				Not Analyzed	
Aroclor-1232	Not Analyzed				Not Analyzed	
Aroclor-1242	Not Analyzed				Not Analyzed	
Aroclor-1248	Not Analyzed				Not Analyzed	
Aroclor-1254	Not Analyzed				Not Analyzed	
Aroclor-1260	Not Analyzed				Not Analyzed	
Gamma-chlordane	3.2 U	0.88	54.0	1.6	0.8	U

PESTICIDE/PCB Chemicals	Avg (ug/kg)	Hot Spot 3 Max (ug/kg)	Max Location
4,4'-DDD	1.2	2.7	PAI-03-SD-55-01
4,4'-DDE	1.1	1.7	PAI-03-SD-55-01
4,4'-DDT	0.7	1.3	PAI-03-SD-55-01
Alpha-chlordane	NA	ND (0.3)	PAI-03-SD-53/55-01
Aroclor-1016	Not Analyzed	-	-
Aroclor-1221	Not Analyzed	-	-
Aroclor-1232	Not Analyzed	-	-
Aroclor-1242	Not Analyzed	-	-
Aroclor-1248	Not Analyzed	-	-
Aroclor-1254	Not Analyzed	-	-
Aroclor-1260	Not Analyzed	-	-
Gamma-chlordane	1.7	3.4	PAI-03-SD-54-01

Notes:
(1) This value was used to calculate the mean concentration for the samples.

NA : Not applicable because all samples in the area did not detect this chemical.

ND: Not dectected at the concentration in paranthesis.

Not Analyzed: The sample was not analyzed for this chemical.

CLIENT: PARRIS ISLAND, SOUTH CAROLINA		JOB NUMBER: 3920 - DRAFT CS
SUBJECT: SITE 3 - CAUSEWAY LANDFILL		
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Hot Spot 4 - Pond Side (samples PAI-03-SD-56 through PAI-03-SD-60)

PESTICIDE/PCB Chemicals	Sample PAI-03-SD-56-01 Concentration (ug/kg)	Laboratory MDL	% Solids	Sample MDL	Concentration Used (1)	
4,4'-DDD	2.1 J	0.603	76.0	0.8	2.1	J
4,4'-DDE	2.8 J	0.302	76.0	0.4	2.8	J
4,4'-DDT	4.3 U	0.546	76.0	0.7	0.4	U
Alpha-chlordane	2.2 U	0.36	76.0	0.5	0.2	U
Aroclor-1016	Not Analyzed				Not Analyzed	
Aroclor-1221	Not Analyzed				Not Analyzed	
Aroclor-1232	Not Analyzed				Not Analyzed	
Aroclor-1242	Not Analyzed				Not Analyzed	
Aroclor-1248	Not Analyzed				Not Analyzed	
Aroclor-1254	Not Analyzed				Not Analyzed	
Aroclor-1260	Not Analyzed				Not Analyzed	
Gamma-chlordane	2.2 U	0.88	76.0	1.2	0.6	U

PESTICIDE/PCB Chemicals	Sample PAI-03-SD-57-01 Concentration (ug/kg)	Laboratory MDL	% Solids	Sample MDL	Concentration Used (1)	
4,4'-DDD	7.8 U	0.603	42.0	1.4	0.7	U
4,4'-DDE	4.2 J	0.302	42.0	0.7	4.2	J
4,4'-DDT	7.8 U	0.546	42.0	1.3	0.7	U
Alpha-chlordane	4.0 U	0.36	42.0	0.9	0.4	U
Aroclor-1016	Not Analyzed				Not Analyzed	
Aroclor-1221	Not Analyzed				Not Analyzed	
Aroclor-1232	Not Analyzed				Not Analyzed	
Aroclor-1242	Not Analyzed				Not Analyzed	
Aroclor-1248	Not Analyzed				Not Analyzed	
Aroclor-1254	Not Analyzed				Not Analyzed	
Aroclor-1260	Not Analyzed				Not Analyzed	
Gamma-chlordane	2.0 J	0.88	42.0	2.1	2.0	J

PESTICIDE/PCB Chemicals	Sample PAI-03-SD-58-01 Concentration (ug/kg)	Laboratory MDL	% Solids	Sample MDL	Concentration Used (1)	
4,4'-DDD	19 U	0.603	85.0	0.7	0.4	U
4,4'-DDE	4.8 J	0.302	85.0	0.4	4.8	J
4,4'-DDT	19 U	0.546	85.0	0.6	0.3	U
Alpha-chlordane	9.6 U	0.36	85.0	0.4	0.2	U
Aroclor-1016	Not Analyzed				Not Analyzed	
Aroclor-1221	Not Analyzed				Not Analyzed	
Aroclor-1232	Not Analyzed				Not Analyzed	
Aroclor-1242	Not Analyzed				Not Analyzed	
Aroclor-1248	Not Analyzed				Not Analyzed	
Aroclor-1254	Not Analyzed				Not Analyzed	
Aroclor-1260	Not Analyzed				Not Analyzed	
Gamma-chlordane	9.6 U	0.88	85.0	1.0	0.5	U

PESTICIDE/PCB Chemicals	Sample PAI-03-SD-59-01 Concentration (ug/kg)	Laboratory MDL	% Solids	Sample MDL	Concentration Used (1)	
4,4'-DDD	58	0.603	44.0	1.4	58.0	
4,4'-DDE	26	0.302	44.0	0.7	26.0	
4,4'-DDT	3.8 J	0.546	44.0	1.2	3.8	J
Alpha-chlordane	2.8 J	0.36	44.0	0.8	2.8	J
Aroclor-1016	Not Analyzed				Not Analyzed	
Aroclor-1221	Not Analyzed				Not Analyzed	
Aroclor-1232	Not Analyzed				Not Analyzed	
Aroclor-1242	Not Analyzed				Not Analyzed	
Aroclor-1248	Not Analyzed				Not Analyzed	
Aroclor-1254	Not Analyzed				Not Analyzed	
Aroclor-1260	Not Analyzed				Not Analyzed	
Gamma-chlordane	3.8 U	0.88	44.0	2.0	1.0	U

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PESTICIDE/PCB Chemicals	Sample PAI-03-SD-60-01 Concentration (ug/kg)	Laboratory MDL	% Solids	Sample MDL	Concentration Used (1)	
4,4'-DDD	12 J	0.603	29.0	2.1	12.0	J
4,4'-DDE	12 J	0.302	29.0	1.0	12.0	J
4,4'-DDT	3.8 J	0.546	29.0	1.9	3.8	J
Alpha-chlordane	5.8 UJ	0.36	29.0	1.2	0.6	UJ
Aroclor-1016	Not Analyzed				Not Analyzed	
Aroclor-1221	Not Analyzed				Not Analyzed	
Aroclor-1232	Not Analyzed				Not Analyzed	
Aroclor-1242	Not Analyzed				Not Analyzed	
Aroclor-1248	Not Analyzed				Not Analyzed	
Aroclor-1254	Not Analyzed				Not Analyzed	
Aroclor-1260	Not Analyzed				Not Analyzed	
Gamma-chlordane	5.8 UJ	0.88	29.0	3.0	1.5	UJ

PESTICIDE/PCB Chemicals	Avg (ug/kg)	Hot Spot 4 Max (ug/kg)	Max Location
4,4'-DDD	14.6	58.0	PAI-03-SD-59
4,4'-DDE	10.0	26	PAI-03-SD-59
4,4'-DDT	1.8	3.8	PAI-03-SD-59/60
Alpha-chlordane	0.9	2.8	PAI-03-SD-59
Aroclor-1016	Not Analyzed	-	-
Aroclor-1221	Not Analyzed	-	-
Aroclor-1232	Not Analyzed	-	-
Aroclor-1242	Not Analyzed	-	-
Aroclor-1248	Not Analyzed	-	-
Aroclor-1254	Not Analyzed	-	-
Aroclor-1260	Not Analyzed	-	-
Gamma-chlordane	1.1	2.0	PAI-03-SD-57

Notes:
(1) This value was used to calculate the mean concentration for the samples.

NA : Not applicable because all samples in the area did not detect this chemical.

ND: Not dectected at the concentration in paranthesis.

Not Analyzed: The sample was not analyzed for this chemical.

CLIENT: PARRIS ISLAND, SOUTH CAROLINA		JOB NUMBER: 3920 - DRAFT CS	
SUBJECT: SITE 3 - CAUSEWAY LANDFILL			
BASED ON: CALCULATION OF INORGANIC AVERAGES AND MAXIMUMS		DRAWING NUMBER:	
BY: KMS Date: 2/8/02	CHECKED BY: Date:	APPROVED BY:	DATE:

Objective:

To calculate an average value for each inorganic analyzed in sediments samples collected at Site 3 for each of 5 areas of the site and to locate the maximum concentration at each area.

Assumptions:

(1) Site 3 will be broken up into five areas for the calculations.

(2) If an iroganic is not detected (ND), 1/2 the detection limit will be used.

(4) To calculate the average concentration of an inorganic for a duplicate sample, the average of the original and duplicate sample will be used.

Calculations:

Marsh Side (samples PAI-03-SD-41 through PAI-03-SD-45)

INORGANIC Chemicals	Sample PAI-03-SD-41-01 Concentration (mg/kg)	Concentration Used (1)
Arsenic	2	2.0
Copper	4.5	4.5
Lead	7	7.0
Mercury	0.01	0.01
Zinc	12.7	12.7

INORGANIC Chemicals	Sample PAI-03-SD-41-01-D Concentration (mg/kg)	Concentration Used (1)
Arsenic	1.8	1.8
Copper	3.5	3.5
Lead	5.3	5.3
Mercury	0.01	0.01
Zinc	9.7	9.7

INORGANIC Chemicals	Sample PAI-03-SD-41-AVG Concentration (mg/kg)	Concentration Used (1)
Arsenic	1.9	1.9
Copper	4	4.0
Lead	6.15	6.2
Mercury	0.01	0.01
Zinc	11.2	11.2

INORGANIC Chemicals	Sample PAI-03-SD-42-01 Concentration (mg/kg)	Concentration Used (1)
Arsenic	2.2	2.2
Copper	5.0	5.0
Lead	13.2	13.2
Mercury	0.04	0.04
Zinc	20.3	20.3

INORGANIC Chemicals	Sample PAI-03-SD-43-01 Concentration (mg/kg)	Concentration Used (1)	
Arsenic	9.5 J	9.5	J
Copper	19.7 J	19.7	J
Lead	19.0 J	19.0	J
Mercury	0.06 J	0.06	J
Zinc	50.3 J	50.3	J

INORGANIC Chemicals	Sample PAI-03-SD-44-01 Concentration (mg/kg)	Concentration Used (1)
Arsenic	13.6	13.6
Copper	27.1	27.1
Lead	27.3	27.3
Mercury	0.06	0.06
Zinc	67.7	67.7

CLIENT: PARRIS ISLAND, SOUTH CAROLINA		JOB NUMBER: 3920 - DRAFT CS
SUBJECT: SITE 3 - CAUSEWAY LANDFILL		
BASED ON: CALCULATION OF INORGANIC AVERAGES AND MAXIMUMS		DRAWING NUMBER:
BY: KMS Date: 2/8/02	CHECKED BY: Date:	APPROVED BY: DATE:

INORGANIC Chemicals	Sample PAI-03-SD-45-01 Concentration (mg/kg)	Concentration Used (1)	
Arsenic	3.8	3.8	
Copper	9.9	9.9	
Lead	12.6	12.6	
Mercury	0.05	0.05	
Zinc	32.0 J	32.0	J

INORGANIC Chemicals	Sample PAI-03-SD-45-01-D Concentration (mg/kg)	Concentration Used (1)	
Arsenic	4.6	4.6	
Copper	11.2	11.2	
Lead	14.2	14.2	
Mercury	0.05	0.05	
Zinc	67.6 J	67.6	J

INORGANIC Chemicals	Sample PAI-03-SD-45-01-AVG Concentration (mg/kg)	Concentration Used (1)	
Arsenic	4.2	4.2	
Copper	10.55	10.6	
Lead	13.4	13.4	
Mercury	0.05	0.05	
Zinc	49.8 J	49.8	J

INORGANIC Chemicals	Avg (mg/kg)	MARSH SIDE Max (mg/kg)	Max Location
Arsenic	6.3	13.6	PAI-03-SD-44-01
Copper	13.3	27.1	PAI-03-SD-44-01
Lead	15.8	27.3	PAI-03-SD-44-01
Mercury	0.04	0.06	PAI-03-SD-43/44-01
Zinc	39.9	67.7	PAI-03-SD-44-01

Notes:
(1) This value was used to calculate the mean concentration for the samples.

CLIENT: PARRIS ISLAND, SOUTH CAROLINA		JOB NUMBER: 3920 - DRAFT CS
SUBJECT: SITE 3 - CAUSEWAY LANDFILL		
BASED ON: CALCULATION OF INORGANIC AVERAGES AND MAXIMUMS		DRAWING NUMBER:
BY: KMS Date: 2/6/02	CHECKED BY: Date:	APPROVED BY: DATE:

Hot Spot 1 - Pond Side (samples PAI-03-SD-46 through PAI-03-SD-49)

INORGANIC Chemicals	Sample PAI-03-SD-46-01 Concentration (mg/kg)	Concentration Used (1)
Arsenic	0.84	0.8
Copper	1.9	1.9
Lead	4.7	4.7
Mercury	0.05	0.05
Zinc	7.3	7.3

INORGANIC Chemicals	Sample PAI-03-SD-47-01 Concentration (mg/kg)	Concentration Used (1)
Arsenic	7.7	7.7
Copper	10.2	10.2
Lead	17.7	17.7
Mercury	0.08	0.08
Zinc	36.1	36.1

INORGANIC Chemicals	Sample PAI-03-SD-48-01 Concentration (mg/kg)	Concentration Used (1)
Arsenic	3.5	3.5
Copper	6.2	6.2
Lead	11.2	11.2
Mercury	0.2	0.20
Zinc	28.6	28.6

INORGANIC Chemicals	Sample PAI-03-SD-49-01 Concentration (mg/kg)	Concentration Used (1)
Arsenic	1	1.0
Copper	1.1	1.1
Lead	4.2	4.2
Mercury	0.04	0.04
Zinc	6.7	6.7

INORGANIC Chemicals	Avg (mg/kg)	HOT SPOT 1 Max (mg/kg)	Max Location
Arsenic	3.3	7.7	PAI-03-SD-47-01
Copper	4.9	10.2	PAI-03-SD-47-01
Lead	9.5	17.7	PAI-03-SD-47-01
Mercury	0.09	0.2	PAI-03-SD-48-01
Zinc	19.7	36.1	PAI-03-SD-47-01

Notes:
(1) This value was used to calculate the mean concentration for the samples.

CLIENT: PARRIS ISLAND, SOUTH CAROLINA		JOB NUMBER: 3920 - DRAFT CS	
SUBJECT: SITE 3 - CAUSEWAY LANDFILL			
BASED ON: CALCULATION OF INORGANIC AVERAGES AND MAXIMUMS		DRAWING NUMBER:	
BY: KMS Date: 2/6/02	CHECKED BY: Date:	APPROVED BY:	DATE:

Hot Spot 2 - Pond Side (samples PAI-03-SD-50 through PAI-03-SD-52)

INORGANIC Chemicals	Sample PAI-03-SD-50-01 Concentration (mg/kg)	Concentration Used (1)
Arsenic	10.5	10.5
Copper	22.5	22.5
Lead	35.8	35.8
Mercury	0.12	0.12
Zinc	72.5	72.5

INORGANIC Chemicals	Sample PAI-03-SD-51-01 Concentration (mg/kg)	Concentration Used (1)
Arsenic	5.2	5.2
Copper	7.7	7.7
Lead	13.3	13.3
Mercury	0.07	0.07
Zinc	25.4	25.4

INORGANIC Chemicals	Sample PAI-03-SD-52-01 Concentration (mg/kg)	Concentration Used (1)
Arsenic	9.3	9.3
Copper	13.8	13.8
Lead	26.8	26.8
Mercury	0.13	0.13
Zinc	48.4	48.4

INORGANIC Chemicals	HOT SPOT 2 Avg (mg/kg)	Max (mg/kg)	Max Location
Arsenic	8.3	10.5	PAI-03-SD-50-01
Copper	14.7	22.5	PAI-03-SD-50-01
Lead	25.3	35.8	PAI-03-SD-50-01
Mercury	0.11	0.13	PAI-03-SD-52-01
Zinc	48.8	72.5	PAI-03-SD-50-01

Notes:
(1) This value was used to calculate the mean concentration for the samples.

CLIENT: PARRIS ISLAND, SOUTH CAROLINA		JOB NUMBER: 3920 - DRAFT CS
SUBJECT: SITE 3 - CAUSEWAY LANDFILL		
BASED ON: CALCULATION OF INORGANIC AVERAGES AND MAXIMUMS		DRAWING NUMBER:
BY: KMS Date: 2/6/02	CHECKED BY: Date:	APPROVED BY: DATE:

Hot Spot 3 - Pond Side (samples PAI-03-SD-53 through PAI-03-SD-55)

INORGANIC Chemicals	Sample PAI-03-SD-53-01 Concentration (mg/kg)	Concentration Used (1)
Arsenic	2.1	2.1
Copper	3.2	3.2
Lead	9.9	9.9
Mercury	0.09	0.09
Zinc	16.5	16.5

INORGANIC Chemicals	Sample PAI-03-SD-54-01 Concentration (mg/kg)	Concentration Used (1)
Arsenic	3.6	3.6
Copper	4.1	4.1
Lead	10	10.0
Mercury	0.04	0.04
Zinc	20.4	20.4

INORGANIC Chemicals	Sample PAI-03-SD-55-01 Concentration (mg/kg)	Concentration Used (1)
Arsenic	5.1	5.1
Copper	5.6	5.6
Lead	13.7	13.7
Mercury	0.05	0.05
Zinc	25.9	25.9

INORGANIC Chemicals	HOT SPOT 3 Avg (mg/kg)	Max (mg/kg)	Max Location
Arsenic	3.6	5.1	PAI-03-SD-55-01
Copper	4.3	5.6	PAI-03-SD-55-01
Lead	11.2	13.7	PAI-03-SD-55-01
Mercury	0.06	0.09	PAI-03-SD-53-01
Zinc	20.9	25.9	PAI-03-SD-55-01

Notes:
(1) This value was used to calculate the mean concentration for the samples.

CLIENT: PARRIS ISLAND, SOUTH CAROLINA		JOB NUMBER: 3920 - DRAFT CS
SUBJECT: SITE 3 - CAUSEWAY LANDFILL		
BASED ON: CALCULATION OF INORGANIC AVERAGES AND MAXIMUMS		DRAWING NUMBER:
BY: KMS Date: 2/8/02	CHECKED BY: Date:	APPROVED BY: DATE:

Hot Spot 4 - Pond Side (samples PAI-03-SD-56 through PAI-03-SD-60)

INORGANIC Chemicals	Sample PAI-03-SD-56-01 Concentration (mg/kg)	Concentration Used (1)
Arsenic	1.9	1.9
Copper	4.2	4.2
Lead	23.2	23.2
Mercury	0.04	0.04
Zinc	49.4	49.4

INORGANIC Chemicals	Sample PAI-03-SD-57-01 Concentration (mg/kg)	Concentration Used (1)
Arsenic	1.6	1.6
Copper	6.8	6.8
Lead	14.6	14.6
Mercury	0.16	0.16
Zinc	65.4	65.4

INORGANIC Chemicals	Sample PAI-03-SD-58-01 Concentration (mg/kg)	Concentration Used (1)	
Arsenic	4.5 J	4.5	J
Copper	7.6 J	7.6	J
Lead	17.2 J	17.2	J
Mercury	0.16 J	0.16	J
Zinc	93.3 J	93.3	J

INORGANIC Chemicals	Sample PAI-03-SD-59-01 Concentration (mg/kg)	Concentration Used (1)
Arsenic	2.3	2.3
Copper	7.6	7.6
Lead	36.4	36.4
Mercury	0.15	0.15
Zinc	38.1	38.1

INORGANIC Chemicals	Sample PAI-03-SD-60-01 Concentration (mg/kg)	Concentration Used (1)	
Arsenic	3.5 J	3.5	J
Copper	13.2 J	13.2	J
Lead	44.9 J	44.9	J
Mercury	0.14 J	0.14	J
Zinc	78.0 J	78.0	J

INORGANIC Chemicals	Avg (mg/kg)	HOT SPOT 4 Max (mg/kg)	Max Location
Arsenic	2.8	4.5	PAI-03-SD-58-01
Copper	7.9	13.2	PAI-03-SD-60-01
Lead	27.3	44.9	PAI-03-SD-60-01
Mercury	0.13	0.16	PAI-03-SD-57/58-01
Zinc	64.8	93.3	PAO-03-SD-60-01

Notes:
(1) This value was used to calculate the mean concentration for the samples.

F-2 1998 RESULTS

CLIENT: PARRIS ISLAND, SOUTH CAROLINA		JOB NUMBER: 3920 - DRAFT CS	
SUBJECT: SITE 3 - CAUSEWAY LANDFILL			
BASED ON: CALCULATION OF PESTICIDE/PCB AVERAGES AND MAXIMUMS - 1998 MARSH SEDIMENT SAMPLES		DRAWING NUMBER:	
BY: KMS Date: 2/7/02	CHECKED BY: Date:	APPROVED BY:	DATE:

Objective:

To calculate the average and maximum values for samples collected on the marsh side of Site 3 in 1998.

Assumptions:

(1) RECRA LABNET soil MDLs will be used to calculate detection limits for Pesticides and PCBs which were not detected in sediment.

(2) If a pesticide or PCB is not detected (ND), 1/2 the laboratory MDL, adjusting for moisture, will be used.
Sample MDL = MDL / Percent Solids in Sample

(3) A 5:1 dilution factor was accounted for on pesticide results from samples PAI-03-SD-09, -11, -12, -13, and -21

Calculations:

Marsh Side (samples PAI-03-SD-21, 09, 11, 12 and 13)

PESTICIDE/PCB Chemicals	Sample PAI-03-SD-21-01 Concentration (ug/kg)	Laboratory MDL	% Solids	Sample MDL	Concentration Used (1)	
4,4'-DDD	35 U	0.371	47.0	3.9	2.0	U
4,4'-DDE	35 U	0.186	47.0	2.0	1.0	U
4,4'-DDT	34 J	1.280	47.0	13.6	34.0	J
Alpha-chlordane	18 U	0.096	47.0	1.0	0.5	U
Aroclor-1016	18 U	4.60	47.0	9.8	4.9	U
Aroclor-1221	18 U	5.64	47.0	12.0	6.0	U
Aroclor-1232	18 U	4.04	47.0	8.6	4.3	U
Aroclor-1242	18 U	2.79	47.0	5.9	3.0	U
Aroclor-1248	18 U	5.34	47.0	11.4	5.7	U
Aroclor-1254	18 U	6.83	47.0	14.5	7.3	U
Aroclor-1260	18 U	4.63	47.0	9.9	4.9	U
Gamma-chlordane	18 U	0.07	47.0	0.7	0.4	U

PESTICIDE/PCB Chemicals	Sample PAI-03-SD-09-01 Concentration (ug/kg)	Laboratory MDL	% Solids	Sample MDL	Concentration Used (1)	
4,4'-DDD	31 U	0.371	53.0	3.5	1.8	U
4,4'-DDE	31 U	0.186	53.0	1.8	0.9	U
4,4'-DDT	31 U	1.280	53.0	12.1	6.0	U
Alpha-chlordane	15 U	0.096	53.0	0.9	0.5	U
Aroclor-1016	15 U	4.60	53.0	8.7	4.3	U
Aroclor-1221	15 U	5.64	53.0	10.6	5.3	U
Aroclor-1232	15 U	4.04	53.0	7.6	3.8	U
Aroclor-1242	15 U	2.79	53.0	5.3	2.6	U
Aroclor-1248	15 U	5.34	53.0	10.1	5.0	U
Aroclor-1254	15 U	6.83	53.0	12.9	6.4	U
Aroclor-1260	15 U	4.63	53.0	8.7	4.4	U
Gamma-chlordane	15 U	0.07	53.0	0.7	0.3	U

PESTICIDE/PCB Chemicals	Sample PAI-03-SD-11 Concentration (ug/kg)	Laboratory MDL	% Solids	Sample MDL	Concentration Used (1)	
4,4'-DDD	30 U	0.371	54.0	3.4	1.7	U
4,4'-DDE	30 U	0.186	54.0	1.7	0.9	U
4,4'-DDT	30 U	1.280	54.0	11.9	5.9	U
Alpha-chlordane	15 U	0.096	54.0	0.9	0.4	U
Aroclor-1016	15 U	4.60	54.0	8.5	4.3	U
Aroclor-1221	15 U	5.64	54.0	10.4	5.2	U
Aroclor-1232	15 U	4.04	54.0	7.5	3.7	U
Aroclor-1242	15 U	2.79	54.0	5.2	2.6	U
Aroclor-1248	15 U	5.34	54.0	9.9	4.9	U
Aroclor-1254	97	6.83	54.0	12.6	97.0	
Aroclor-1260	45	4.63	54.0	8.6	45.0	
Gamma-chlordane	15 U	0.07	54.0	0.6	0.3	U

CLIENT: PARRIS ISLAND, SOUTH CAROLINA		JOB NUMBER: 3920 - DRAFT CS
SUBJECT: SITE 3 - CAUSEWAY LANDFILL		
BASED ON: CALCULATION OF PESTICIDE/PCB AVERAGES AND MAXIMUMS - 1998 MARSH SEDIMENT SAMPLES		DRAWING NUMBER:
BY: KMS Date: 2/7/02	CHECKED BY: Date:	APPROVED BY: DATE:

PESTICIDE/PCB Chemicals	Sample PAI-03-SD-12-01 Concentration (ug/kg)	Laboratory MDL	% Solids	Sample MDL	Concentration Used (1)	
4,4'-DDD	34 U	0.371	48.0	3.9	1.9	U
4,4'-DDE	34 U	0.186	48.0	1.9	1.0	U
4,4'-DDT	34 U	1.280	48.0	13.3	6.7	U
Alpha-chlordane	17 U	0.096	48.0	1.0	0.5	U
Aroclor-1016	17 U	4.60	48.0	9.6	4.8	U
Aroclor-1221	17 U	5.64	48.0	11.8	5.9	U
Aroclor-1232	17 U	4.04	48.0	8.4	4.2	U
Aroclor-1242	17 U	2.79	48.0	5.8	2.9	U
Aroclor-1248	17 U	5.34	48.0	11.1	5.6	U
Aroclor-1254	17 U	6.83	48.0	14.2	7.1	U
Aroclor-1260	17 U	4.63	48.0	9.6	4.8	U
Gamma-chlordane	17 U	0.07	48.0	0.7	0.4	U

PESTICIDE/PCB Chemicals	Sample PAI-03-SD-13-01 Concentration (ug/kg)	Laboratory MDL	% Solids	Sample MDL	Concentration Used (1)	
4,4'-DDD	47 U	0.371	35.0	5.3	2.7	U
4,4'-DDE	47 U	0.186	35.0	2.7	1.3	U
4,4'-DDT	47 U	1.280	35.0	18.3	9.1	U
Alpha-chlordane	24.0 U	0.096	35.0	1.4	0.7	U
Aroclor-1016	24 U	4.60	35.0	13.1	6.6	U
Aroclor-1221	24 U	5.64	35.0	16.1	8.1	U
Aroclor-1232	24 U	4.04	35.0	11.5	5.8	U
Aroclor-1242	24 U	2.79	35.0	8.0	4.0	U
Aroclor-1248	24 U	5.34	35.0	15.3	7.6	U
Aroclor-1254	24 U	6.83	35.0	19.5	9.8	U
Aroclor-1260	24 U	4.63	35.0	13.2	6.6	U
Gamma-chlordane	24.0 U	0.07	35.0	1.0	0.5	U

PESTICIDE/PCB Chemicals	Avg (ug/kg)	MARSH SIDE Max (ug/kg)	Max Location
4,4'-DDD	NA	ND(47)	PAI-03-SD-13
4,4'-DDE	NA	ND(47)	PAI-03-SD-13
4,4'-DDT	12.4	34.0	PAI-03-SD-21
Alpha-chlordane	NA	ND(24)	PAI-03-SD-13
Aroclor-1016	NA	ND(24)	PAI-03-SD-13
Aroclor-1221	NA	ND(24)	PAI-03-SD-13
Aroclor-1232	NA	ND(24)	PAI-03-SD-13
Aroclor-1242	NA	ND(24)	PAI-03-SD-13
Aroclor-1248	NA	ND(24)	PAI-03-SD-13
Aroclor-1254	25.5	97	PAI-03-SD-11
Aroclor-1260	13.1	45	PAI-03-SD-11
Gamma-chlordane	NA	ND(24)	PAI-03-SD-13

Notes:
(1) This value was used to calculate the mean concentration for the samples.

NA : Not applicable because all samples in the area did not detect this chemical.

ND: Not dectected at the concentration in paranthesis.

TETRA TECH NUS, INC. **CALCULATION SHEET**

CLIENT: PARRIS ISLAND, SOUTH CAROLINA		JOB NUMBER: 3920 - DRAFT CS	
SUBJECT: SITE 3 - CAUSEWAY LANDFILL			
BASED ON: CALCULATION OF INORGANIC AVERAGES AND MAXIMUMS - 1998 MARSH SEDIMENT SAMPLES		DRAWING NUMBER:	
BY: KMS Date: 2/7/02	CHECKED BY: Date:	APPROVED BY:	DATE:

Objective:

To calculate the average and maximum values for samples collected on the marsh side of Site 3 in 1998.

Assumptions:

(1) If an iroganic is not detected (ND), 1/2 the detection limit will be used.

Calculations:

Marsh Side (samples PAI-03-SD-21, 9, 11, 12 and 13)

INORGANIC Chemicals	Sample PAI-03-SD-21-01 Concentration (mg/kg)	Concentration Used (1)	
Arsenic	2.6	2.6	
Copper	8.5	8.5	
Lead	10.6	10.6	
Mercury	0.04 U	0.02	U
Zinc	18.2	18.2	

INORGANIC Chemicals	Sample PAI-03-SD-09-01 Concentration (mg/kg)	Concentration Used (1)	
Arsenic	8.4	8.4	
Copper	3	3.0	
Lead	12.9	12.9	
Mercury	0.04 U	0.02	U
Zinc	19.2	19.2	

INORGANIC Chemicals	Sample PAI-03-SD-11-01 Concentration (mg/kg)	Concentration Used (1)	
Arsenic	5.2	5.2	
Copper	10.9	10.9	
Lead	44	44.0	
Mercury	0.04 U	0.02	U
Zinc	32.9	32.9	

INORGANIC Chemicals	Sample PAI-03-SD-12-01 Concentration (mg/kg)	Concentration Used (1)	
Arsenic	6.6	6.6	
Copper	20.5	20.5	
Lead	24.1	24.1	
Mercury	0.05 U	0.03	U
Zinc	54.1	54.1	

INORGANIC Chemicals	Sample PAI-03-SD-13-01 Concentration (mg/kg)	Concentration Used (1)	
Arsenic	4.9	4.9	
Copper	16.4	16.4	
Lead	19.4	19.4	
Mercury	0.05 U	0.03	U
Zinc	36.3	36.3	

INORGANIC Chemicals	MARSH SIDE Avg (mg/kg)	Max (mg/kg)	Max Location
Arsenic	5.5	8.4	PAI-03-SD-09-01
Copper	11.9	20.5	PAI-03-SD-12-01
Lead	22.2	44.0	PAI-03-SD-11-01
Mercury	NA	ND(0.05)	PAI-03-SD-12/13-01
Zinc	32.1	54.1	PAI-03-SD-13-01

Notes:
(1) This value was used to calculate the mean concentration for the samples.

NA : Not applicable because all samples in the area did not detect this chemical.

ND: Not dectected at the concentration in paranthesis.

APPENDIX G

DEVELOPMENT OF BIOTA-SEDIMENT ACCUMULATION FACTORS FOR 4,4'-DDD AND MERCURY

APPENDIX G

DEVELOPMENT OF BIOTA-SEDIMENT ACCUMULATION FACTORS FOR 4,4'-DDD AND MERCURY

4,4'-DDD

The biota-sediment accumulation factors (BSAFs) for 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT were obtained from the U.S. Army Corps of Engineers (USACE) web site (http://el.erdc.usace.army.mil/bsaf/bsaf.html) by U.S. EPA on February 9, 2009. Of the BSAFs reported on this website, only BSAFs for fish and for the DDT pesticides were evaluated. The BSAFs were then grouped by pesticides (i.e., DDT, DDE, and DDD) for the whole body fish results and median BSAFs for whole fish for 4,4'-DDD (2.7), 4,4'-DDE (14.5) and 4,4-DDT (1.2) were calculated (Table G-1).

A cursory review of the literature did not reveal an approach for predicting fillet concentrations for DDT compounds from whole body fish residues. However, the USACE database cited above does have BSAFs based on fillet tissue for DDE in Dover sole (a Pacific Flatfish). These BSAFs are about an order of magnitude lower than whole body DDE BSAFs. Since whole body BSAFs are expected to be higher than fillet BSAFs because the hydrophobic DDT chemicals preferentially accumulate in body lipids that are found largely in non-muscle tissue. Because the degree of hydrophobicity is similar for the DDT chemicals, the whole body BSAFs were reduced by an order of magnitude to obtain fillet BSAFs.

CHEMICAL	WHOLE BODY BSAF	FILLET BSAF
4,4'-DDD	2.7	0.27
4,4'-DDE	14.5	1.45
4,4'-DDT	1.2	0.12

MERCURY

Although there are some uncertainties in the Evans & Engel (1994) fish bioaccumulation model, it was used to estimate wet weigh mercury in whole body fish (Table G-2). The following equation by Peterson et al. (2005) was used to estimate fillet concentrations from whole body concentrations.

$$\log10[\text{whole body Hg}] = -0.2712 + 0.9005\ \log10[\text{muscle Hg}]$$

SEDIMENT CONCENTRATION (mg/kg)		WHOLE BODY CONCENTRATION (mg/kg)	FILLET CONCENTRATION (mg/kg)
Maximum	0.2	0.24	0.45
95% UCL	0.121	0.17	0.33
2 times average bckgrd	0.09	0.15	0.28

REFERENCES

Evans, D.W. and D.W. Engel, May 1994. Mercury Bioaccumulation in Finfish and Shellfish from Lavaca Bay, Texas: Descriptive Models and Annotated Bibliography. NOAA Tech. Memo NMFS-DEFSC-348.

Peterson S.A., Sickle J.V., Hughes R.M., Schacher J.A., and Echols S.F., 2005. A Biopsy Procedure for Determining Filet and Predicting Whole-Fish Mercury Concentration. Archives of Environmental Contamination and Toxicology, 48:99-107.

U.S. Army Corps of Engineers (USACE), February 2009. BSAF Database, http://el.erdc.usace.army.mil/bsaf/bsaf.html.

TABLE G-1

BIOTA-SEDIMENT ACCUMULATION FACTORS
FOR 4,4'-DDD, 4,4'-DDE, AND 4,4-DDT
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

Chemical	Organism	G	BSAF	(n)	Wet/Dry	Tissue
DDD [O,P']	*Cyprinus carpio*	FB	0.53	1	Both	Whole
DDD [P,P']	*Cyprinus carpio*	FB	2	1	Both	Whole
DDD [O,P']	*Catostomus commersoni*	FB	2.4	1	Both	Whole
DDD [P,P']	*Catostomus commersoni*	FB	2.724	22	Both	Whole
DDD [P,P']	*Oncorhynchus mykiss*	FB	3.15	4	Both	Whole
DDD [P,P']	*Ictalurus punctatus*	FB	4.05	2	Both	Whole
DDD [P,P']	*Catostomus macrocheilus*	FB	4.4	1	Both	Whole

DDD	**Mean**	2.8
	Median	2.7
	Std. Dev.	1.3
	%CV	47%
	n	32

Chemical	Organism	G	BSAF	(n)	Wet/Dry	Tissue
DDE [P,P']	*Catostomus columbianus*	FB	4.36	5	Both	Whole
DDE [P,P']	*Cottus spp.*	FB	5.225	8	Both	Whole
DDE [P,P']	*Oncorhynchus mykiss*	FB	6.02	5	Both	Whole
DDE [P,P']	*Cottus beldingii*	FB	8.6	1	Both	Whole
DDE [P,P']	*Catostomus commersoni*	FB	10.385	34	Both	Whole
DDE [P,P']	*Gambusia holbrooki*	FM	14.533	3	Both	Whole
DDE [P,P']	*Ictalurus punctatus*	FB	17.5	2	Both	Whole
DDE [P,P']	*Catostomus macrocheilus*	FB	18.275	4	Both	Whole
DDE [P,P']	*Salmo trutta*	FM	26	1	Both	Whole
DDE [P,P']	*Micropterus dolomieu*	FM	30	2	Both	Whole
DDE [P,P']	*Cyprinus carpio*	FB	41.471	7	Both	Whole

DDE	**Mean**	16.6
	Median	14.5
	Std. Dev.	11.8
	%CV	71%
	n	72

Chemical	Organism	G	BSAF	(n)	Wet/Dry	Tissue
DDT [P,P']	*Catostomus columbianus*	FB	0.27	1	Both	Whole
DDT [O,P']	*Catostomus columbianus*	FB	0.49	1	Both	Whole
DDT [P,P']	*Oncorhynchus mykiss*	FB	0.715	4	Both	Whole
DDT [O,P']	*Catostomus commersoni*	FB	0.74	1	Both	Whole
DDT [P,P']	*Catostomus commersoni*	FB	1.047	14	Both	Whole
DDT [P,P']	*Cyprinus carpio*	FB	1.365	2	Both	Whole
DDT [P,P']	*Catostomus macrocheilus*	FB	1.37	2	Both	Whole
DDT [O,P']	*Oncorhynchus mykiss*	FB	1.4	1	Both	Whole
DDT [P,P']	*Cottus spp.*	FB	2.15	2	Both	Whole
DDT [P,P']	*Micropterus dolomieu*	FM	5.2	1	Both	Whole

DDT	**Mean**	1.5
	Median	1.2
	Std. Dev.	1.4
	%CV	96%
	n	29

FB = bottom feeding fish
FM = mid-water feeding fish
FP = plankton feeding fish

TABLE G-2

BIOTA-SEDIMENT ACCUMULATION FACTOR - MERCURY
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

The Basic E&E Model

	$C_{\text{total Hg sediment}}$	Proportion of total Hg that is MeHg	C_{sediment}	MeHg Partition Coefficient between water and sediment	C_{water}
	(ppm total Hg)	in sediments	(ppm MeHg)	(L/g)	(ppb MeHg)
max sed	**0.2**	0.005	0.001	100	0.00001
avg bkgrd	**0.045**	0.005	0.000225	100	0.00000225
2x avg bkgrd	**0.09**	0.005	0.00045	100	0.0000045
95% UCL	**0.121**	0.005	0.000605	100	0.00000605

Evans, D.W. and D.W. Engel. 1994. Mercury bioaccumulation in finfish and shellfish from Lavaca Bay, Texas: Descriptive models and annotated bibliography. NOAA Tech. Memo NMFS-DEFSC-348

TABLE G-2

BIOTA-SEDIMENT ACCUMULATION FACTOR - MERCURY
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

	% Diet $_{fish}$	Biota Sed. Factor	P $_{crustaceans}$	Dry wt : Wet wt.	C $_{crustaceans}$	% Diet $_{crustaceans}$
	30%		(Proportion of Hg that is MeHg)		(ppm MeHg wet wt.)	60%
max sed	0.3	2	0.7	0.2	0.056	0.6
avg bkgrd	0.3	2	0.7	0.2	0.0126	0.6
2x avg bkgrd	0.3	2	0.7	0.2	0.0252	0.6
95% UCL	0.3	2	0.7	0.2	0.03388	0.6

TABLE G-2

BIOTA-SEDIMENT ACCUMULATION FACTOR - MERCURY
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

	$C_{\text{other inverts.}}$	% Diet $_{\text{other inverts.}}$	Assimilation efficiency	Feeding Rate	MeHg Excretion Rate	Growth Rate
	(ppm MeHg wet wt.)	10%	of red drum	(g/g/day)	(per day)	(per day)
max sed	0.02	0.1	0.8	0.02	0.00035	0.003
avg bkgrd	0.0045	0.1	0.8	0.02	0.00035	0.003
2x avg bkgrd	0.009	0.1	0.8	0.02	0.00035	0.003
95% UCL	0.0121	0.1	0.8	0.02	0.00035	0.003

TABLE G-2

BIOTA-SEDIMENT ACCUMULATION FACTOR - MERCURY
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

	$C_{juvenile\ red\ drum}$				C_{fillet}
	(ppm MeHg wet wt)				
max sed	**0.24**		-0.616774308	-0.345747181	0.45
avg bkgrd	**0.11**		-0.959008206	-0.688152282	0.21
2x avg bkgrd	**0.15**		-0.829283031	-0.558362212	0.28
95% UCL	**0.17**		-0.758180053	-0.487223665	0.33

APPENDIX H

HUMAN HEALTH RISK ASSESSMENT SUPPORTING INFORMATION

H-1 PROUCL OUTPUTS

H-2 RAGS PART D TABLES

H-3 SAMPLE CALCULATIONS

H-1 PROUCL OUTPUTS

	General UCL Statistics for Full Data Sets		
User Selected Options			
From File	Pond Data.xls.wst		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
TEQ PCB - Full DL			
General Statistics			
Number of Valid Observations	18	Number of Distinct Observations	18
Raw Statistics		Log-transformed Statistics	
Minimum	0.672	Minimum of Log Data	-0.397
Maximum	5.241	Maximum of Log Data	1.657
Mean	1.952	Mean of log Data	0.432
Median	1.305	SD of log Data	0.683
SD	1.488		
Coefficient of Variation	0.762		
Skewness	1.256		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.79	Shapiro Wilk Test Statistic	0.897
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	2.562	95% H-UCL	2.81
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	3.341
95% Adjusted-CLT UCL	2.64	97.5% Chebyshev (MVUE) UCL	3.958
95% Modified-t UCL	2.579	99% Chebyshev (MVUE) UCL	5.169

TEQ PCB - Full DL (Continued)			
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.922	Data Follow Appr. Gamma Distribution at 5% Significance Level	
Theta Star	1.015		
MLE of Mean	1.952		
MLE of Standard Deviation	1.408		
nu star	69.21		
Approximate Chi Square Value (.05)	51.06	Nonparametric Statistics	
Adjusted Level of Significance	0.0357	95% CLT UCL	2.529
Adjusted Chi Square Value	49.56	95% Jackknife UCL	2.562
		95% Standard Bootstrap UCL	2.511
Anderson-Darling Test Statistic	0.96	95% Bootstrap-t UCL	2.774
Anderson-Darling 5% Critical Value	0.751	95% Hall's Bootstrap UCL	2.536
Kolmogorov-Smirnov Test Statistic	0.195	95% Percentile Bootstrap UCL	2.561
Kolmogorov-Smirnov 5% Critical Value	0.206	95% BCA Bootstrap UCL	2.553
Data follow Appr. Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	3.481
		97.5% Chebyshev(Mean, Sd) UCL	4.142
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	5.442
95% Approximate Gamma UCL	2.646		
95% Adjusted Gamma UCL	2.726		
Potential UCL to Use		Use 95% Approximate Gamma UCL	2.646

4,4'-DDE			
General Statistics			
Number of Valid Observations	18	Number of Distinct Observations	18
Raw Statistics		**Log-transformed Statistics**	
Minimum	1.5	Minimum of Log Data	0.405
Maximum	64.5	Maximum of Log Data	4.167
Mean	17.45	Mean of log Data	2.187
Median	7.05	SD of log Data	1.247
SD	19.51		
Coefficient of Variation	1.118		
Skewness	1.287		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.799	Shapiro Wilk Test Statistic	0.926
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	25.45	95% H-UCL	48.27
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	44.66
95% Adjusted-CLT UCL	26.5	97.5% Chebyshev (MVUE) UCL	56.15
95% Modified-t UCL	25.68	99% Chebyshev (MVUE) UCL	78.73
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.765	**Data appear Gamma Distributed at 5% Significance Level**	
Theta Star	22.83		
MLE of Mean	17.45		
MLE of Standard Deviation	19.96		
nu star	27.52		
Approximate Chi Square Value (.05)	16.56	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0357	95% CLT UCL	25.01
Adjusted Chi Square Value	15.74	95% Jackknife UCL	25.45
		95% Standard Bootstrap UCL	24.72
Anderson-Darling Test Statistic	0.669	95% Bootstrap-t UCL	28.26
Anderson-Darling 5% Critical Value	0.772	95% Hall's Bootstrap UCL	25.8
Kolmogorov-Smirnov Test Statistic	0.172	95% Percentile Bootstrap UCL	24.88
Kolmogorov-Smirnov 5% Critical Value	0.21	95% BCA Bootstrap UCL	25.74
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	37.49
		97.5% Chebyshev(Mean, Sd) UCL	46.16
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	63.2
95% Approximate Gamma UCL	29.01		
95% Adjusted Gamma UCL	30.51		
Potential UCL to Use		Use 95% Approximate Gamma UCL	29.01

	General UCL Statistics for Data Sets with Non-Detects		
User Selected Options			
From File	WorkSheet.wst		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
MERCURY			
General Statistics			
Number of Valid Data	18	Number of Detected Data	7
Number of Distinct Detected Data	7	Number of Non-Detect Data	11
		Percent Non-Detects	61.11%
Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.0155	Minimum Detected	-4.167
Maximum Detected	0.56	Maximum Detected	-0.58
Mean of Detected	0.172	Mean of Detected	-2.68
SD of Detected	0.225	SD of Detected	1.519
Minimum Non-Detect	0.0019	Minimum Non-Detect	-6.266
Maximum Non-Detect	0.106	Maximum Non-Detect	-2.244
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	15
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	3
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	83.33%
Warning: There are only 7 Detected Values in this data			
Note: It should be noted that even though bootstrap may be performed on this data set			
the resulting calculations may not be reliable enough to draw conclusions			
It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.			
UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.751	Shapiro Wilk Test Statistic	0.864
5% Shapiro Wilk Critical Value	0.803	5% Shapiro Wilk Critical Value	0.803
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

MERCURY (continued)			
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.0743	Mean	-4.461
SD	0.156	SD	2.087
95% DL/2 (t) UCL	0.138	95% H-Stat (DL/2) UCL	0.65
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	-5.069
		SD in Log Scale	2.21
		Mean in Original Scale	0.0679
		SD in Original Scale	0.158
		95% Percentile Bootstrap UCL	0.134
		95% BCA Bootstrap UCL	0.158
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.474	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	0.363		
nu star	6.634		
A-D Test Statistic	0.58	Nonparametric Statistics	
5% A-D Critical Value	0.742	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.742	Mean	0.0768
5% K-S Critical Value	0.324	SD	0.15
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.0383
		95% KM (t) UCL	0.143
Assuming Gamma Distribution		95% KM (z) UCL	0.14
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.139
Minimum	0.0155	95% KM (bootstrap t) UCL	0.382
Maximum	0.56	95% KM (BCA) UCL	0.159
Mean	0.179	95% KM (Percentile Bootstrap) UCL	0.146
Median	0.171	95% KM (Chebyshev) UCL	0.244
SD	0.135	97.5% KM (Chebyshev) UCL	0.316
k star	1.308	99% KM (Chebyshev) UCL	0.458
Theta star	0.137		
Nu star	47.09	Potential UCLs to Use	
AppChi2	32.34	95% KM (t) UCL	0.143
95% Gamma Approximate UCL	0.261		
95% Adjusted Gamma UCL	0.271		
Note: DL/2 is not a recommended method.			

4,4'-DDD			
General Statistics			
Number of Valid Data	18	Number of Detected Data	10
Number of Distinct Detected Data	9	Number of Non-Detect Data	8
		Percent Non-Detects	44.44%
Raw Statistics		Log-transformed Statistics	
Minimum Detected	2.4	Minimum Detected	0.875
Maximum Detected	14	Maximum Detected	2.639
Mean of Detected	6	Mean of Detected	1.607
SD of Detected	4.04	SD of Detected	0.625
Minimum Non-Detect	0.34	Minimum Non-Detect	-1.079
Maximum Non-Detect	0.42	Maximum Non-Detect	-0.868
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	8
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	10
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	44.44%
UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.826	Shapiro Wilk Test Statistic	0.904
5% Shapiro Wilk Critical Value	0.842	5% Shapiro Wilk Critical Value	0.842
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	3.416	Mean	0.144
SD	4.181	SD	1.745
95% DL/2 (t) UCL	5.13	95% H-Stat (DL/2) UCL	16.71
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	1.426	Mean in Log Scale	0.861
SD	6.341	SD in Log Scale	0.989
95% MLE (t) UCL	4.026	Mean in Original Scale	3.762
95% MLE (Tiku) UCL	4.463	SD in Original Scale	3.912
		95% Percentile Bootstrap UCL	5.27
		95% BCA Bootstrap UCL	5.716

4,4'-DDD (continued)			
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	2.072	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	2.896		
nu star	41.43		
A-D Test Statistic	0.585	**Nonparametric Statistics**	
5% A-D Critical Value	0.733	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.733	Mean	4.4
5% K-S Critical Value	0.269	SD	3.371
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.837
		95% KM (t) UCL	5.857
Assuming Gamma Distribution		95% KM (z) UCL	5.778
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	5.822
Minimum	1.563	95% KM (bootstrap t) UCL	6.819
Maximum	14	95% KM (BCA) UCL	6.178
Mean	5.438	95% KM (Percentile Bootstrap) UCL	5.964
Median	4.862	95% KM (Chebyshev) UCL	8.051
SD	3.244	97.5% KM (Chebyshev) UCL	9.63
k star	2.934	99% KM (Chebyshev) UCL	12.73
Theta star	1.853		
Nu star	105.6	Potential UCLs to Use	
AppChi2	82.91	95% KM (t) UCL	5.857
95% Gamma Approximate UCL	6.928		
95% Adjusted Gamma UCL	7.093		
Note: DL/2 is not a recommended method.			

4,4'-DDT			
General Statistics			
Number of Valid Data	18	Number of Detected Data	13
Number of Distinct Detected Data	11	Number of Non-Detect Data	5
		Percent Non-Detects	27.78%
Raw Statistics		Log-transformed Statistics	
Minimum Detected	1.6	Minimum Detected	0.47
Maximum Detected	6.5	Maximum Detected	1.872
Mean of Detected	3.446	Mean of Detected	1.138
SD of Detected	1.67	SD of Detected	0.454
Minimum Non-Detect	0.34	Minimum Non-Detect	-1.079
Maximum Non-Detect	4.2	Maximum Non-Detect	1.435
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	15
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	3
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	83.33%
UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.851	Shapiro Wilk Test Statistic	0.927
5% Shapiro Wilk Critical Value	0.866	5% Shapiro Wilk Critical Value	0.866
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	2.647	Mean	0.491
SD	1.974	SD	1.256
95% DL/2 (t) UCL	3.457	95% H-Stat (DL/2) UCL	6.672
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	3.719	Mean in Log Scale	0.892
SD	2.195	SD in Log Scale	0.575
95% MLE (t) UCL	4.619	Mean in Original Scale	2.858
95% MLE (Tiku) UCL	5.676	SD in Original Scale	1.722
		95% Percentile Bootstrap UCL	3.534
		95% BCA Bootstrap UCL	3.61

4,4'-DDT (continued)			
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	4.062	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	0.848		
nu star	105.6		
A-D Test Statistic	0.555	Nonparametric Statistics	
5% A-D Critical Value	0.736	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.736	Mean	2.975
5% K-S Critical Value	0.237	SD	1.579
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.39
		95% KM (t) UCL	3.653
Assuming Gamma Distribution		95% KM (z) UCL	3.616
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	3.605
Minimum	1.571	95% KM (bootstrap t) UCL	3.825
Maximum	6.5	95% KM (BCA) UCL	3.756
Mean	3.053	95% KM (Percentile Bootstrap) UCL	3.659
Median	2.4	95% KM (Chebyshev) UCL	4.674
SD	1.625	97.5% KM (Chebyshev) UCL	5.41
k star	3.688	99% KM (Chebyshev) UCL	6.854
Theta star	0.828		
Nu star	132.8	Potential UCLs to Use	
AppChi2	107.2	95% KM (Percentile Bootstrap) UCL	3.659
95% Gamma Approximate UCL	3.783		
95% Adjusted Gamma UCL	3.862		
Note: DL/2 is not a recommended method.			

	General UCL Statistics for Full Data Sets		
User Selected Options			
From File	Reference Sample Data.wst		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

TEQ PCB - FULL DL

General Statistics			
Number of Valid Observations	9	Number of Distinct Observations	9
Raw Statistics		Log-transformed Statistics	
Minimum	0.549	Minimum of Log Data	-0.6
Maximum	2.072	Maximum of Log Data	0.728
Mean	1.261	Mean of log Data	0.124
Median	1.267	SD of log Data	0.511
SD	0.578		
Coefficient of Variation	0.459		
Skewness	0.066		

Warning: There are only 9 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set,

the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.922	Shapiro Wilk Test Statistic	0.902
Shapiro Wilk Critical Value	0.829	Shapiro Wilk Critical Value	0.829
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	1.62	95% H-UCL	1.935
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	2.227
95% Adjusted-CLT UCL	1.583	97.5% Chebyshev (MVUE) UCL	2.641
95% Modified-t UCL	1.621	99% Chebyshev (MVUE) UCL	3.454

TEQ PCB - FULL DL (Continued)			
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	3.27	Data appear Normal at 5% Significance Level	
Theta Star	0.386		
MLE of Mean	1.261		
MLE of Standard Deviation	0.697		
nu star	58.86		
Approximate Chi Square Value (.05)	42.22	Nonparametric Statistics	
Adjusted Level of Significance	0.0231	95% CLT UCL	1.578
Adjusted Chi Square Value	39.27	95% Jackknife UCL	1.62
		95% Standard Bootstrap UCL	1.565
Anderson-Darling Test Statistic	0.381	95% Bootstrap-t UCL	1.633
Anderson-Darling 5% Critical Value	0.723	95% Hall's Bootstrap UCL	1.542
Kolmogorov-Smirnov Test Statistic	0.193	95% Percentile Bootstrap UCL	1.554
Kolmogorov-Smirnov 5% Critical Value	0.28	95% BCA Bootstrap UCL	1.569
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	2.102
		97.5% Chebyshev(Mean, Sd) UCL	2.465
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	3.18
95% Approximate Gamma UCL	1.758		
95% Adjusted Gamma UCL	1.891		
Potential UCL to Use		Use 95% Student's-t UCL	1.62

	General UCL Statistics for Data Sets with Non-Detects
User Selected Options	
From File	Reference Sample Data.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

4,4'-DDE

General Statistics			
Number of Valid Data	9	Number of Detected Data	6
Number of Distinct Detected Data	6	Number of Non-Detect Data	3
		Percent Non-Detects	33.33%
Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.888	Minimum Detected	-0.119
Maximum Detected	5.1	Maximum Detected	1.629
Mean of Detected	2.365	Mean of Detected	0.709
SD of Detected	1.497	SD of Detected	0.597
Minimum Non-Detect	0.25	Minimum Non-Detect	-1.386
Maximum Non-Detect	0.31	Maximum Non-Detect	-1.171
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	3
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	6
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	33.33%

Warning: There are only 6 Detected Values in this data

Note: It should be noted that even though bootstrap may be performed on this data set

the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.878	Shapiro Wilk Test Statistic	0.988
5% Shapiro Wilk Critical Value	0.788	5% Shapiro Wilk Critical Value	0.788
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

4,4'-DDE Continued)

Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	1.622	Mean	-0.192
SD	1.625	SD	1.433
95% DL/2 (t) UCL	2.63	95% H-Stat (DL/2) UCL	3.871
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	1.233	Mean in Log Scale	0.185
SD	2.048	SD in Log Scale	0.917
95% MLE (t) UCL	2.502	Mean in Original Scale	1.717
95% MLE (Tiku) UCL	2.611	SD in Original Scale	1.531
		95% Percentile Bootstrap UCL	2.601
		95% BCA Bootstrap UCL	2.734
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	1.837	Data appear Normal at 5% Significance Level	
Theta Star	1.287		
nu star	22.04		
A-D Test Statistic	0.23	**Nonparametric Statistics**	
5% A-D Critical Value	0.701	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.701	Mean	1.872
5% K-S Critical Value	0.334	SD	1.315
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.48
		95% KM (t) UCL	2.765
Assuming Gamma Distribution		95% KM (z) UCL	2.662
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	2.7
Minimum	0.888	95% KM (bootstrap t) UCL	3.505
Maximum	5.1	95% KM (BCA) UCL	3.011
Mean	1.982	95% KM (Percentile Bootstrap) UCL	2.744
Median	1.5	95% KM (Chebyshev) UCL	3.966
SD	1.316	97.5% KM (Chebyshev) UCL	4.872
k star	2.457	99% KM (Chebyshev) UCL	6.651
Theta star	0.806		
Nu star	44.23	Potential UCLs to Use	
AppChi2	29.98	95% KM (t) UCL	2.765
95% Gamma Approximate UCL	2.924	95% KM (Percentile Bootstrap) UCL	2.744
95% Adjusted Gamma UCL	3.184		

Note: DL/2 is not a recommended method.

H-2 RAGS-PART D TABLES

TABLE 3.1.RME
EXPOSURE POINT CONCENTRATION SUMMARY
SITE 3 - CAUSEWAY LANDFILL - POND
MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current/Future
Medium: Fish
Exposure Medium: Fish

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Pond	Mercury	mg/kg	0.143	0.143 (G)	0.564	0.143	mg/kg	95% KM(T)	PRO UCL 4.0.04
	TEQ PCB	mg/kg	0.000007	0.0000026 (G)	6.97 E-6	0.0000026	mg/kg	95% APPROXIMATE GAMMA	PRO UCL 4.0.04
	4,4'-DDD	mg/kg	0.003	0.0059 (G)	0.014 J	0.0059	mg/kg	95% KM(T)	PRO UCL 4.0.04
	4,4'-DDE	mg/kg	0.018	0.029 (G)	0.071 J	0.029	mg/kg	95% APPROXIMATE GAMMA	PRO UCL 4.0.04
	4,4'-DDT	mg/kg	0.003	0.0037 (G)	0.0072 J	0.0037	mg/kg	95% KM(PERCENTILE BOOTSTRAP)	PRO UCL 4.0.04

For non-detects, one half the sample quantitation limit was used as a proxy concentration.
G - Gamma distribution.
N - Normal distribution.
NP - Non-parmetric distribution.
J - Estimated value.

TABLE 4.1

VALUES USED FOR DAILY INTAKE CALCULATIONS

SITE 3 - CAUSEWAY LANDFILL - POND

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Finfish/Shellfish

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational	Child	Pond	CFish	Chemical Concentration in Fish	Max or 95% UCL	mg/kg	U.S. EPA, 2002	Intake (mg/kg/day) =
				IR	Ingestion Rate of fish/shellfish	0.0175	kg/meal	U.S. EPA, 2000	$\frac{\text{CFish x IR x FI x EF x ED}}{\text{BW x AT}}$
				FI	Fraction ingested from source	1	unitless	- -	
				EF	Exposure Frequency	365	meals/year	- -	
				ED	Exposure Duration	3	years	(1)	
				BW	Body Weight	17	kg	U.S. EPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	U.S. EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	1095	days	U.S. EPA, 1989	

Notes

1 - Assumes a child ages 3 to <6 years (U.S. EPA, November 2000).

Sources:

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. U.S. EPA/540/1-86/060.

U.S. EPA, 2000: Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. U.S. EPA/823-B-00-007.

U.S. EPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

TABLE 4.2
VALUES USED FOR DAILY INTAKE CALCULATIONS
SITE 3 - CAUSEWAY LANDFILL - POND
MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe:	Current/Future
Medium:	Surface Water
Exposure Medium:	Finfish/Shellfish

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Subsistence	Child	Pond	CFish	Chemical Concentration in Fish	Max or 95% UCL	mg/kg	U.S. EPA, 2002	Intake (mg/kg/day) =
				IR	Ingestion Rate of fish/shellfish	0.1424	kg/meal	U.S. EPA, 2000	CFish x IR x FI x EF x ED
				FI	Fraction ingested from source	1	unitless	- -	BW x AT
				EF	Exposure Frequency	365	meals/year	- -	
				ED1	Exposure Duration (Age 6 - 16)	3	years	(1)	
				BW	Body Weight	30	kg	(2)	
				AT-C	Averaging Time (Cancer)	25550	days	U.S. EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	1095	days	U.S. EPA, 1989	

Notes

1 - Assumes a child age 8 to 10 (based on interview with civilian subsistence fisher).

2 - Approximate average weight of child 6 to >9 (25 kg) and child 9 to <12 (36 kg) (U.S. EPA, November 2000).

Sources:

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. U.S. EPA/540/1-86/060.

U.S. EPA, 2000: Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. U.S. EPA/823-B-00-007.

U.S. EPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

TABLE 4.3

VALUES USED FOR DAILY INTAKE CALCULATIONS

SITE 3 - CAUSEWAY LANDFILL - POND

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Finfish/Shellfish

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational-Military	Adult	Pond	CFish	Chemical Concentration in Fish	Max or 95% UCL	mg/kg	U.S. EPA, 2002	Intake (mg/kg/day) =
				IR	Ingestion Rate of fish/shellfish	0.0175	kg/meal	U.S. EPA, 2000	CFish x IR x FI x EF x ED
				FI	Fraction ingested from source	1	unitless	- -	BW x AT
				EF	Exposure Frequency	365	meals/year	- -	
				ED	Exposure Duration	6	years	(1)	
				BW	Body Weight	70	kg	U.S. EPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	U.S. EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2190	days	U.S. EPA, 1989	

Notes

1 - Assumes military personnel stationed at the base who spends two 3-year tours of duty at the site.

Sources:

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. U.S. EPA/540/1-86/060.

U.S. EPA, 2000: Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. U.S. EPA/823-B-00-007.

U.S. EPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

TABLE 4.4

VALUES USED FOR DAILY INTAKE CALCULATIONS

SITE 3 - CAUSEWAY LANDFILL - POND

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Finfish/Shellfish

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational-Civilian	Adult	Pond	CFish	Chemical Concentration in Fish	Max or 95% UCL	mg/kg	U.S. EPA, 2002	Intake (mg/kg/day) =
				IR	Ingestion Rate of fish/shellfish	0.0175	kg/meal	U.S. EPA, 2000	$\frac{CFish \times IR \times FI \times EF \times ED}{BW \times AT}$
				FI	Fraction ingested from source	1	unitless	- -	
				EF	Exposure Frequency	365	meals/year	- -	
				ED	Exposure Duration	70	years	U.S. EPA, 2000	
				BW	Body Weight	70	kg	U.S. EPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	U.S. EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	25550	days	U.S. EPA, 1989	

Sources:

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. U.S. EPA/540/1-86/060.

U.S. EPA, 2000: Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. U.S. EPA/823-B-00-007.

U.S. EPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

TABLE 4.5

VALUES USED FOR DAILY INTAKE CALCULATIONS

SITE 3 - CAUSEWAY LANDFILL - POND

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Finfish/Shellfish

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Subsistence	Adult	Pond	CFish	Chemical Concentration in Fish	Max or 95% UCL	mg/kg	U.S. EPA, 2002	Intake (mg/kg/day) =
				IR	Ingestion Rate of fish/shellfish	0.1424	kg/meal	U.S. EPA, 2000	$\frac{\text{CFish x IR x FI x EF x ED}}{\text{BW x AT}}$
				FI	Fraction ingested from source	1	unitless	- -	
				EF	Exposure Frequency	365	meals/year	- -	
				ED	Exposure Duration	70	years	U.S. EPA, 2000	
				BW	Body Weight	70	kg	U.S. EPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	U.S. EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	25550	days	U.S. EPA, 1989	

Sources:

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. U.S. EPA/540/1-86/060.

U.S. EPA, 2000: Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. U.S. EPA/823-B-00-007.

U.S. EPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

TABLE 4.6.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

SITE 3 - CAUSEWAY LANDFILL - POND

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current
Medium: Surface Water
Exposure Medium: Finfish/Shellfish

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	USEPA Region IV Default	Adult	Pond	CFish	Chemical Concentration in Fish	Max or 95% UCL	mg/kg	U.S. EPA, 2002	Intake (mg/kg/day) =
				IR	Ingestion Rate of fish/shellfish	0.054	kg/meal	U.S. EPA Region IV, 2000	CFish x IR x FI x EF x ED
				FI	Fraction ingested from source	1	unitless	- -	BW x AT
				EF	Exposure Frequency	350	meals/year	- -	
				ED	Exposure Duration	30	years	U.S. EPA Region IV, 2000	
				BW	Body Weight	70	kg	U.S. EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	U.S. EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	10,950	days	U.S. EPA, 1989	

Sources:

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. U.S. EPA/540/1-86/060.

U.S. EPA Region IV, 2000: Supplemental Guidance to RAGS: Region 4 Bulletins, Human Health Risk Assessment Bulletins. EPA Region 4, originally published November 1995, Website version last updated September 2008.

U.S. EPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

TABLE 5.1
NON-CANCER TOXICITY DATA -- ORAL/DERMAL
SITE 3 - CAUSEWAY LANDFILL - POND
MCRD PARRIS ISLAND, SOUTH CAROLINA

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal[1]	Absorbed RfD for Dermal[2]		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD:Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Pesticides										
4,4'-DDD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dioxin-Like PCBs										
2,3,7,8-TCDD (dioxin-like PCBs)	Chronic	1.0E-09	mg/kg/day	1	1.0E-09	mg/kg/day	NA	NA	ATSDR	12/2009
Inorganics										
Copper	Chronic	4.0E-02	mg/kg/day	1	4.0E-02	mg/kg/day	GS	NA	HEAST	7/1997
Mercury[3]	Chronic	1.0E-04	mg/kg/day	1	1.0E-04	mg/kg/day	CNS	10/1	IRIS	5/13/2010

1 - U.S. EPA, July 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.
2 - Adjusted dermal RfD = Oral RfD x Oral Absorption Efficiency for Dermal.
3 - Values are for methyl mercury.
ATSDR = Agency for Toxic Substances and Disease Registry
CNS = Central Nervous System
GS = Gastrointestinal
HEAST = Health Effects Assessment Summary Tables
IRIS = Integrated Risk Information System
NA = Not applicable

TABLE 6.1
CANCER TOXICITY DATA -- ORAL/DERMAL
SITE 3 - CAUSEWAY LANDFILL - POND
MCRD PARRIS ISLAND, SOUTH CAROLINA

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal[1]	Absorbed Cancer Slope Factor for Dermal[2]		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units		Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Pesticides								
4,4'-DDD	2.4E-01	$(mg/kg/day)^{-1}$	1	2.4E-01	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	IRIS	5/13/2010
4,4'-DDE	3.4E-01	$(mg/kg/day)^{-1}$	1	3.4E-01	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	IRIS	5/13/2010
4,4'-DDT	3.4E-01	$(mg/kg/day)^{-1}$	1	3.4E-01	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	IRIS	5/13/2010
Dioxin-Like PCBs								
2,3,7,8-TCDD (dioxin-like PCBs)	1.3E+05	$(mg/kg/day)^{-1}$	1	1.3E+05	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	ATSDR	12/2009
Inorganics								
Copper	NA	NA	NA	NA	NA	D / Not classifiable as to human carcinogenicity	IRIS	5/13/2010
Mercury	NA	NA	NA	NA	NA	C / Inadequate data of carcinogenicity in humans	IRIS	5/13/2010

1 - U.S. EPA, July 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.
2 - Adjusted cancer slope factor for dermal = Oral cancer slope factor / Oral Absorption Efficiency for Dermal.
ATSDR = Agency for Toxic Substances and Disease Registry
IRIS = Integrated Risk Information System.
NA = Not available.

TABLE 7.1.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS - CHILD RECREATIONAL FISHER

SITE 3 - CAUSEWAY LANDFILL - POND

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current
Receptor Population: Recreational Fisher
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Fish	Fish	Pond	Ingestion	Mercury	0.143	mg/kg	6.3E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.5E-04	(mg/kg/day)	1.0E-04	(mg/kg/day)	1.5
				TEQ PCB	2.6E-6	mg/kg	1.1E-10	(mg/kg/day)	1.3E+05	$(mg/kg/day)^{-1}$	1.5E-05	2.7E-09	(mg/kg/day)	1.0E-09	(mg/kg/day)	2.7
				4,4'-DDD	0.006	mg/kg	2.6E-07	(mg/kg/day)	2.4E-01	$(mg/kg/day)^{-1}$	6.2E-08	6.1E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				4,4'-DDE	0.029	mg/kg	1.3E-06	(mg/kg/day)	3.4E-01	$(mg/kg/day)^{-1}$	4.4E-07	3.0E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				4,4'-DDT	0.004	mg/kg	1.6E-07	(mg/kg/day)	3.4E-01	$(mg/kg/day)^{-1}$	5.6E-08	3.8E-06	(mg/kg/day)	5.0E-04	(mg/kg/day)	0.008
			Exp. Route Total								1.5E-05					4.2
		Exposure Point Total									1.5E-05					4.2
	Exposure Medium Total										1.5E-05					4.2
Medium Total											1.5E-05					4.2
										Total of Receptor Risks Across All Media	1.5E-05				Total of Receptor Hazards Across All Media	4.2

TABLE 7.2.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS - CHILD SUBSISTENCE FISHER

SITE 3 - CAUSEWAY LANDFILL - POND

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current
Receptor Population: Subsistence Fisher
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Fish	Fish	Pond	Ingestion	Mercury	0.143	mg/kg	2.9E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	6.8E-04	(mg/kg/day)	1.0E-04	(mg/kg/day)	6.8
				TEQ PCB	2.6E-6	mg/kg	5.3E-10	(mg/kg/day)	1.3E+05	$(mg/kg/day)^{-1}$	6.9E-05	1.2E-08	(mg/kg/day)	1.0E-09	(mg/kg/day)	12
				4,4'-DDD	0.006	mg/kg	1.2E-06	(mg/kg/day)	2.4E-01	$(mg/kg/day)^{-1}$	2.9E-07	2.8E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				4,4'-DDE	0.029	mg/kg	5.9E-06	(mg/kg/day)	3.4E-01	$(mg/kg/day)^{-1}$	2.0E-06	1.4E-04	(mg/kg/day)	NA	(mg/kg/day)	--
				4,4'-DDT	0.004	mg/kg	7.5E-07	(mg/kg/day)	3.4E-01	$(mg/kg/day)^{-1}$	2.6E-07	1.8E-05	(mg/kg/day)	5.0E-04	(mg/kg/day)	0.04
			Exp. Route Total								7.1E-05					19
		Exposure Point Total									7.1E-05					19
	Exposure Medium Total										7.1E-05					19
Medium Total											7.1E-05					19
									Total of Receptor Risks Across All Media		7.1E-05			Total of Receptor Hazards Across All Media		19

TABLE 7.3.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS - CHILD SUBSISTENCE FISHER

SITE 3 - CAUSEWAY LANDFILL - POND

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current
Receptor Population: Recreational Military Fisher
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Fish	Fish	Pond	Ingestion	Mercury	0.143	mg/kg	3.1E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.6E-05	(mg/kg/day)	1.0E-04	(mg/kg/day)	0.4
				TEQ PCB	2.6E-6	mg/kg	5.6E-11	(mg/kg/day)	1.3E+05	$(mg/kg/day)^{-1}$	7.2E-06	6.5E-10	(mg/kg/day)	1.0E-09	(mg/kg/day)	0.7
				4,4'-DDD	0.006	mg/kg	1.3E-07	(mg/kg/day)	2.4E-01	$(mg/kg/day)^{-1}$	3.0E-08	1.5E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				4,4'-DDE	0.029	mg/kg	6.2E-07	(mg/kg/day)	3.4E-01	$(mg/kg/day)^{-1}$	2.1E-07	7.3E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				4,4'-DDT	0.004	mg/kg	7.9E-08	(mg/kg/day)	3.4E-01	$(mg/kg/day)^{-1}$	2.7E-08	9.3E-07	(mg/kg/day)	5.0E-04	(mg/kg/day)	0.002
			Exp. Route Total								7.5E-06					1.0
		Exposure Point Total									7.5E-06					1.0
	Exposure Medium Total										7.5E-06					1.0
Medium Total											7.5E-06					1.0
									Total of Receptor Risks Across All Media		7.5E-06		Total of Receptor Hazards Across All Media			1.0

TABLE 7.4.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS - ADULT RECREATIONAL CIVILIAN FISHER

SITE 3 - CAUSEWAY LANDFILL - POND

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current
Receptor Population: Recreational Civilian Fisher
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Fish	Fish	Pond	Ingestion	Mercury	0.143	mg/kg	3.6E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.6E-05	(mg/kg/day)	1.0E-04	(mg/kg/day)	0.4
				TEQ PCB	2.6E-6	mg/kg	6.5E-10	(mg/kg/day)	1.3E+05	$(mg/kg/day)^{-1}$	8.5E-05	6.5E-10	(mg/kg/day)	1.0E-09	(mg/kg/day)	0.7
				4,4'-DDD	0.006	mg/kg	1.5E-06	(mg/kg/day)	2.4E-01	$(mg/kg/day)^{-1}$	3.5E-07	1.5E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				4,4'-DDE	0.029	mg/kg	7.3E-06	(mg/kg/day)	3.4E-01	$(mg/kg/day)^{-1}$	2.5E-06	7.3E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				4,4'-DDT	0.004	mg/kg	9.3E-07	(mg/kg/day)	3.4E-01	$(mg/kg/day)^{-1}$	3.1E-07	9.3E-07	(mg/kg/day)	5.0E-04	(mg/kg/day)	0.002
			Exp. Route Total								8.8E-05					1.0
		Exposure Point Total									8.8E-05					1.0
	Exposure Medium Total										8.8E-05					1.0
Medium Total											8.8E-05					1.0
										Total of Receptor Risks Across All Media	8.8E-05				Total of Receptor Hazards Across All Media	1.0

TABLE 7.5.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS - ADULT SUBSISTENCE FISHER

SITE 3 - CAUSEWAY LANDFILL - POND

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current
Receptor Population: Subsistence Fisher
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Fish	Fish	Pond	Ingestion	Mercury	0.143	mg/kg	2.9E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.9E-04	(mg/kg/day)	1.0E-04	(mg/kg/day)	2.9
				TEQ PCB	2.6E-6	mg/kg	5.3E-09	(mg/kg/day)	1.3E+05	$(mg/kg/day)^{-1}$	6.9E-04	5.3E-09	(mg/kg/day)	1.0E-09	(mg/kg/day)	5.3
				4,4'-DDD	0.006	mg/kg	1.2E-05	(mg/kg/day)	2.4E-01	$(mg/kg/day)^{-1}$	2.9E-06	1.2E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				4,4'-DDE	0.029	mg/kg	5.9E-05	(mg/kg/day)	3.4E-01	$(mg/kg/day)^{-1}$	2.0E-05	5.9E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				4,4'-DDT	0.004	mg/kg	7.5E-06	(mg/kg/day)	3.4E-01	$(mg/kg/day)^{-1}$	2.6E-06	7.5E-06	(mg/kg/day)	5.0E-04	(mg/kg/day)	0.02
			Exp. Route Total								7.1E-04					8.2
		Exposure Point Total									7.1E-04					8.2
	Exposure Medium Total										7.1E-04					8.2
Medium Total											7.1E-04					8.2
										Total of Receptor Risks Across All Media	7.1E-04				Total of Receptor Hazards Across All Media	8.2

TABLE 7.6.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS - USEPA REGION IV DEFAULT

SITE 3 - CAUSEWAY LANDFILL - POND

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current
Receptor Population: USEPA Region IV Default
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Fish	Fish	Pond	Ingestion	Mercury	0.143	mg/kg	4.5E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.1E-04	(mg/kg/day)	1.0E-04	(mg/kg/day)	1.1
				TEQ PCB	2.6E-6	mg/kg	8.2E-10	(mg/kg/day)	1.3E+05	$(mg/kg/day)^{-1}$	1.1E-04	1.9E-09	(mg/kg/day)	1.0E-09	(mg/kg/day)	1.9
				4,4'-DDD	0.006	mg/kg	1.9E-06	(mg/kg/day)	2.4E-01	$(mg/kg/day)^{-1}$	4.5E-07	4.4E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				4,4'-DDE	0.029	mg/kg	9.2E-06	(mg/kg/day)	3.4E-01	$(mg/kg/day)^{-1}$	3.1E-06	2.1E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				4,4'-DDT	0.004	mg/kg	1.2E-06	(mg/kg/day)	3.4E-01	$(mg/kg/day)^{-1}$	4.0E-07	2.7E-06	(mg/kg/day)	5.0E-04	(mg/kg/day)	0.005
			Exp. Route Total								1.1E-04					3.0
		Exposure Point Total									1.1E-04					3.0
	Exposure Medium Total										1.1E-04					3.0
Medium Total											1.1E-04					3.0
										Total of Receptor Risks Across All Media	1.1E-04				Total of Receptor Hazards Across All Media	3.0

TABLE 9.1.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - CHILD RECREATIONAL FISHER

SITE 3 - CAUSEWAY LANDFILL - POND

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current
Receptor Population: Recreational Fisher
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Fish	Fish	Pond	Mercury	- -	--	- -	--	- -	CNS	1	- -	--	1
			TEQ PCB	1E-05	--	- -	--	1E-05	NA	3	- -	--	3
			4,4'-DDD	6E-08	--	- -	--	6E-08	NA	--	- -	--	--
			4,4'-DDE	4E-07	--	- -	--	4E-07	NA	--	- -	--	--
			4,4'-DDT	6E-08	--	- -	--	6E-08	Liver	0.008	- -	--	0.008
			Chemical Total	2E-05	--	- -	--	2E-05		4	--	--	4
		Exposure Point Total						2E-05					4
	Exposure Medium Total							2E-05					4
Medium Total								2E-05					4
Receptor Total							Receptor Risk Total	2E-05				Receptor HI Total	4

Total CNS HI	1
Total Liver HI	0.008
Total NA HI	3

TABLE 9.2.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - CHILD SUBSISTENCE FISHER

SITE 3 - CAUSEWAY LANDFILL - POND

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current
Receptor Population: Subsistence Fisher
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Fish	Fish	Pond	Mercury	- -	--	- -	--	- -	CNS	7	- -	--	7
			TEQ PCB	7E-05	--	- -	--	7E-05	NA	12	- -	--	12
			4,4'-DDD	3E-07	--	- -	--	3E-07	NA	--	- -	--	--
			4,4'-DDE	2E-06	--	- -	--	2E-06	NA	--	- -	--	--
			4,4'-DDT	3E-07	--	- -	--	3E-07	Liver	0.04	- -	--	0.04
			Chemical Total	7E-05	--	- -	--	7E-05		19	--	--	19
		Exposure Point Total						7E-05					19
	Exposure Medium Total							7E-05					19
Medium Total								7E-05					19
Receptor Total							Receptor Risk Total	7E-05				Receptor HI Total	19

Total CNS HI	7
Total Liver HI	0.04
Total NA HI	12

TABLE 9.3.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - ADULT RECREATIONAL MILITARY FISHER

SITE 3 - CAUSEWAY LANDFILL - POND

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current
Receptor Population: Recreational Military Fisher
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Fish	Fish	Pond	Mercury	- -	--	- -	--	- -	CNS	0.4	- -	--	0.4
			TEQ PCB	7E-06	--	- -	--	7E-06	NA	0.7	- -	--	0.7
			4,4'-DDD	3E-08	--	- -	--	3E-08	NA	--	- -	--	--
			4,4'-DDE	2E-07	--	- -	--	2E-07	NA	--	- -	--	--
			4,4'-DDT	3E-08	--	- -	--	3E-08	Liver	0.002	- -	--	0.002
			Chemical Total	8E-06	--	- -	--	8E-06		1	--	--	1
		Exposure Point Total						8E-06					1
	Exposure Medium Total							8E-06					1
Medium Total								8E-06					1
Receptor Total							Receptor Risk Total	8E-06				Receptor HI Total	1

Total CNS HI	0.4
Total Liver HI	0.002
Total NA HI	0.7

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TABLE 9.4.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - ADULT RECREATIONAL CIVILIAN FISHER

SITE 3 - CAUSEWAY LANDFILL - POND

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current
Receptor Population: Recreational Civilian Fisher
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Fish	Fish	Pond	Mercury	- -	--	- -	--	- -	CNS	0.4	- -	--	0.4
			TEQ PCB	8E-05	--	- -	--	8E-05	NA	0.7	- -	--	0.7
			4,4'-DDD	4E-07	--	- -	--	4E-07	NA	--	- -	--	--
			4,4'-DDE	2E-06	--	- -	--	2E-06	NA	--	- -	--	--
			4,4'-DDT	3E-07	--	- -	--	3E-07	Liver	0.002	- -	--	0.002
			Chemical Total	9E-05	--	- -	--	9E-05		1	--	--	1
		Exposure Point Total						9E-05					1
	Exposure Medium Total							9E-05					1
Medium Total								9E-05					1
Receptor Total							Receptor Risk Total	9E-05				Receptor HI Total	1

Total CNS HI	0.4
Total Liver HI	0.002
Total NA HI	0.7

5/19/2010

TABLE 9.5.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - ADULT SUBSISTENCE FISHER

SITE 3 - CAUSEWAY LANDFILL - POND

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current
Receptor Population: Subsistence Fisher
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Fish	Fish	Pond	Mercury	- -	--	- -	--	- -	CNS	3	- -	--	3
			TEQ PCB	7E-04	--	- -	--	7E-04	NA	5	- -	--	5
			4,4'-DDD	3E-06	--	- -	--	3E-06	NA	--	- -	--	--
			4,4'-DDE	2E-05	--	- -	--	2E-05	NA	--	- -	--	--
			4,4'-DDT	3E-06	--	- -	--	3E-06	Liver	0.02	- -	--	0.02
			Chemical Total	7E-04	--	- -	--	7E-04		8	--	--	8
		Exposure Point Total						7E-04					8
	Exposure Medium Total							7E-04					8
Medium Total								7E-04					8
Receptor Total							Receptor Risk Total	7E-04				Receptor HI Total	8

Total CNS HI	3
Total Liver HI	0.02
Total NA HI	5

TABLE 9.6.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - USEPA REGION IV DEFAULT

SITE 3 - CAUSEWAY LANDFILL - POND

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current
Receptor Population: USEPA Region IV Default
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Fish	Fish	Pond	Mercury	- -	--	- -	--	- -	CNS	1.1	- -	--	1
			TEQ PCB	1E-04	--	- -	--	1E-04	NA	1.9	- -	--	2
			4,4'-DDD	4E-07	--	- -	--	4E-07	NA	--	- -	--	--
			4,4'-DDE	3E-06	--	- -	--	3E-06	NA	--	- -	--	--
			4,4'-DDT	4E-07	--	- -	--	4E-07	Liver	0.005	- -	--	0.005
			Chemical Total	1E-04	--	- -	--	1E-04		3	--	--	3
		Exposure Point Total						1E-04					3
	Exposure Medium Total							1E-04					3
Medium Total								1E-04					3
Receptor Total							Receptor Risk Total	1E-04				Receptor HI Total	3

Total CNS HI	1
Total Liver HI	0.005
Total NA HI	2

TABLE 3.1.RME
EXPOSURE POINT CONCENTRATION SUMMARY - REFERENCE LOCATION
SITE 3 - CAUSEWAY LANDFILL - REFERENCE LOCATION
MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current/Future
Medium: Fish
Exposure Medium: Fish

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Reference Location	Mercury	mg/kg	NA	NA	0.0235	0.0235	mg/kg	MAXIMUM CONCENTRATION	ONE DETECTION
	TEQ PCB	mg/kg	0.0000013	0.000002	0.0000017	0.00000162	mg/kg	95% STUDENT'S T UCL	PRO UCL 4.0.04
	4,4'-DDD	mg/kg	NA	NA	0.0015	0.0015	mg/kg	MAXIMUM CONCENTRATION	ONE DETECTION
	4,4'-DDE	mg/kg	0.002	0.0028	0.0051	0.0028	mg/kg	95% KM (T) UCL	PRO UCL 4.0.04
	4,4'-DDT	mg/kg	NA	NA	0.0013	0.0013	mg/kg	MAXIMUM CONCENTRATION	ONE DETECTION

G - Gamma distribution.
N - Normal distribution.
NP - Non-parmetric distribution.
J - Estimated value.
NA - Not Applicable

TABLE 4.1

VALUES USED FOR DAILY INTAKE CALCULATIONS

SITE 3 - CAUSEWAY LANDFILL - REFERENCE LOCATION

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe:	Current/Future
Medium:	Surface Water
Exposure Medium:	Finfish/Shellfish

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational	Child	Reference Location	CFish	Chemical Concentration in Fish	Max or 95% UCL	mg/kg	U.S. EPA, 2002	Intake (mg/kg/day) =
				IR	Ingestion Rate of fish/shellfish	0.0175	kg/meal	U.S. EPA, 2000	$\frac{\text{CFish x IR x FI x EF x ED}}{\text{BW x AT}}$
				FI	Fraction ingested from source	1	unitless	- -	
				EF	Exposure Frequency	365	meals/year	- -	
				ED	Exposure Duration	3	years	(1)	
				BW	Body Weight	17	kg	U.S. EPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	U.S. EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	1095	days	U.S. EPA, 1989	

Notes

1 - Assumes a child ages 3 to <6 years (U.S. EPA, November 2000).

Sources:

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. U.S. EPA/540/1-86/060.

U.S. EPA, 2000: Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. U.S. EPA/823-B-00-007.

U.S. EPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

TABLE 4.2

VALUES USED FOR DAILY INTAKE CALCULATIONS

SITE 3 - CAUSEWAY LANDFILL - REFERENCE LOCATION

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Finfish/Shellfish

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Subsistence	Child	Reference Location	CFish	Chemical Concentration in Fish	Max or 95% UCL	mg/kg	U.S. EPA, 2002	Intake (mg/kg/day) =
				IR	Ingestion Rate of fish/shellfish	0.1424	kg/meal	U.S. EPA, 2000	CFish x IR x FI x EF x ED
				FI	Fraction ingested from source	1	unitless	- -	BW x AT
				EF	Exposure Frequency	365	meals/year	- -	
				ED1	Exposure Duration (Age 6 - 16)	3	years	(1)	
				BW	Body Weight	30	kg	(2)	
				AT-C	Averaging Time (Cancer)	25550	days	U.S. EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	1095	days	U.S. EPA, 1989	

Notes

1 - Assumes a child age 8 to 10 (based on interview with civilian subsistence fisher).

2 - Approximate average weight of child 6 to >9 (25 kg) and child 9 to <12 (36 kg) (U.S. EPA, November 2000).

Sources:

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. U.S. EPA/540/1-86/060.

U.S. EPA, 2000: Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. U.S. EPA/823-B-00-007.

U.S. EPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

TABLE 4.3

VALUES USED FOR DAILY INTAKE CALCULATIONS

SITE 3 - CAUSEWAY LANDFILL - REFERENCE LOCATION

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Finfish/Shellfish

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational-Military	Adult	Reference Location	CFish	Chemical Concentration in Fish	Max or 95% UCL	mg/kg	U.S. EPA, 2002	Intake (mg/kg/day) =
				IR	Ingestion Rate of fish/shellfish	0.0175	kg/meal	U.S. EPA, 2000	$\frac{\text{CFish x IR x FI x EF x ED}}{\text{BW x AT}}$
				FI	Fraction ingested from source	1	unitless	- -	
				EF	Exposure Frequency	365	meals/year	- -	
				ED	Exposure Duration	6	years	(1)	
				BW	Body Weight	70	kg	U.S. EPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	U.S. EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2190	days	U.S. EPA, 1989	

Notes

1 - Assumes military personnel stationed at the base who spends two 3-year tours of duty at the site.

Sources:

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. U.S. EPA/540/1-86/060.

U.S. EPA, 2000: Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. U.S. EPA/823-B-00-007.

U.S. EPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

TABLE 4.4

VALUES USED FOR DAILY INTAKE CALCULATIONS

SITE 3 - CAUSEWAY LANDFILL - REFERENCE LOCATION

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Finfish/Shellfish

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational-Civilian	Adult	Reference Location	CFish	Chemical Concentration in Fish	Max or 95% UCL	mg/kg	U.S. EPA, 2002	Intake (mg/kg/day) =
				IR	Ingestion Rate of fish/shellfish	0.0175	kg/meal	U.S. EPA, 2000	$\frac{\text{CFish x IR x FI x EF x ED}}{\text{BW x AT}}$
				FI	Fraction ingested from source	1	unitless	- -	
				EF	Exposure Frequency	365	meals/year	- -	
				ED	Exposure Duration	70	years	U.S. EPA, 2000	
				BW	Body Weight	70	kg	U.S. EPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	U.S. EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	25550	days	U.S. EPA, 1989	

Sources:

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. U.S. EPA/540/1-86/060.

U.S. EPA, 2000: Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. U.S. EPA/823-B-00-007.

U.S. EPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

TABLE 4.5

VALUES USED FOR DAILY INTAKE CALCULATIONS

SITE 3 - CAUSEWAY LANDFILL - REFERENCE LOCATION

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Finfish/Shellfish

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Subsistence	Adult	Reference Location	CFish	Chemical Concentration in Fish	Max or 95% UCL	mg/kg	U.S. EPA, 2002	Intake (mg/kg/day) =
				IR	Ingestion Rate of fish/shellfish	0.1424	kg/meal	U.S. EPA, 2000	$\frac{CFish \times IR \times FI \times EF \times ED}{BW \times AT}$
				FI	Fraction ingested from source	1	unitless	- -	
				EF	Exposure Frequency	365	meals/year	- -	
				ED	Exposure Duration	70	years	U.S. EPA, 2000	
				BW	Body Weight	70	kg	U.S. EPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	U.S. EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	25550	days	U.S. EPA, 1989	

Sources:

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. U.S. EPA/540/1-86/060.

U.S. EPA, 2000: Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. U.S. EPA/823-B-00-007.

U.S. EPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

TABLE 4.6.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
SITE 3 - CAUSEWAY LANDFILL - REFERENCE LOCATION
MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current
Medium: Surface Water
Exposure Medium: Finfish/Shellfish

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	USEPA Region IV Default	Adult	Reference Location	CFish	Chemical Concentration in Fish	Max or 95% UCL	mg/kg	U.S. EPA, 2002	Intake (mg/kg/day) =
				IR	Ingestion Rate of fish/shellfish	0.054	kg/meal	U.S. EPA Region IV, 2000	CFish x IR x FI x EF x ED
				FI	Fraction ingested from source	1	unitless	- -	BW x AT
				EF	Exposure Frequency	350	meals/year	- -	
				ED	Exposure Duration	30	years	U.S. EPA Region IV, 2000	
				BW	Body Weight	70	kg	U.S. EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	U.S. EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	10,950	days	U.S. EPA, 1989	

Sources:

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. U.S. EPA/540/1-86/060.

U.S. EPA Region IV, 2000: Supplemental Guidance to RAGS: Region 4 Bulletins, Human Health Risk Assessment Bulletins. EPA Region 4, originally published November 1995, Website version last updated September 2008.

U.S. EPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

TABLE 5.1
NON-CANCER TOXICITY DATA -- ORAL/DERMAL
SITE 3 - CAUSEWAY LANDFILL - REFERENCE LOCATION
MCRD PARRIS ISLAND, SOUTH CAROLINA

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal[1]	Absorbed RfD for Dermal[2]		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD:Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Pesticides										
4,4'-DDD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dioxin-Like PCBs										
2,3,7,8-TCDD (dioxin-like PCBs)	Chronic	1.0E-09	mg/kg/day	1	1.0E-09	mg/kg/day	NA	NA	ATSDR	12/2009
Inorganics										
Mercury[3]	Chronic	1.0E-04	mg/kg/day	1	1.0E-04	mg/kg/day	CNS	10/1	IRIS	5/13/2010

1 - U.S. EPA, July 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.
2 - Adjusted dermal RfD = Oral RfD x Oral Absorption Efficiency for Dermal.
3 - Values are for methyl mercury.
ATSDR = Agency for Toxic Substances and Disease Registry
CNS = Central Nervous System
GS = Gastrointestinal
HEAST = Health Effects Assessment Summary Tables
IRIS = Integrated Risk Information System
NA = Not applicable

TABLE 6.1
CANCER TOXICITY DATA -- ORAL/DERMAL
SITE 3 - CAUSEWAY LANDFILL - REFERENCE LOCATION
MCRD PARRIS ISLAND, SOUTH CAROLINA

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal (1)	Absorbed Cancer Slope Factor for Dermal (2)		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units		Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Pesticides								
4,4'-DDD	2.4E-01	$(mg/kg/day)^{-1}$	1	2.4E-01	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	IRIS	5/13/2010
4,4'-DDE	3.4E-01	$(mg/kg/day)^{-1}$	1	3.4E-01	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	IRIS	5/13/2010
4,4'-DDT	3.4E-01	$(mg/kg/day)^{-1}$	1	3.4E-01	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	IRIS	5/13/2010
Dioxin-Like PCBs								
2,3,7,8-TCDD (dioxin-like PCBs)	1.3E+05	$(mg/kg/day)^{-1}$	1	1.3E+05	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	ATSDR	12/2009
Inorganics								
Mercury	NA	NA	NA	NA	NA	C / Inadequate data of carcinogenicity in humans	IRIS	5/13/2010

1 - U.S. EPA, July 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.
2 - Adjusted cancer slope factor for dermal = Oral cancer slope factor / Oral Absorption Efficiency for Dermal.
ATSDR = Agency for Toxic Substances and Disease Registry
IRIS = Integrated Risk Information System.
NA = Not available.

TABLE 7.1.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS - CHILD RECREATIONAL FISHER

SITE 3 - CAUSEWAY LANDFILL - REFERENCE LOCATION

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current
Receptor Population: Recreational Fisher
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Fish	Fish	Reference Location	Ingestion	Mercury	0.024	mg/kg	1.0E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.4E-05	(mg/kg/day)	1.0E-04	(mg/kg/day)	0.2
				TEQ PCB	1.6E-6	mg/kg	7.1E-11	(mg/kg/day)	1.3E+05	$(mg/kg/day)^{-1}$	9.3E-06	1.7E-09	(mg/kg/day)	1.0E-09	(mg/kg/day)	1.7
				4,4'-DDD	0.002	mg/kg	6.6E-08	(mg/kg/day)	2.4E-01	$(mg/kg/day)^{-1}$	1.6E-08	1.5E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				4,4'-DDE	0.003	mg/kg	1.2E-07	(mg/kg/day)	3.4E-01	$(mg/kg/day)^{-1}$	4.2E-08	2.9E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				4,4'-DDT	0.001	mg/kg	5.7E-08	(mg/kg/day)	3.4E-01	$(mg/kg/day)^{-1}$	2.0E-08	1.3E-06	(mg/kg/day)	5.0E-04	(mg/kg/day)	0.003
			Exp. Route Total								9.4E-06					1.9
		Exposure Point Total									9.4E-06					1.9
	Exposure Medium Total										9.4E-06					1.9
Medium Total											9.4E-06					1.9
									Total of Receptor Risks Across All Media		9.4E-06			Total of Receptor Hazards Across All Media		1.9

TABLE 7.2.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS - CHILD SUBSISTENCE FISHER

SITE 3 - CAUSEWAY LANDFILL - REFERENCE LOCATION

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current
Receptor Population: Subsistence Fisher
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Fish	Fish	Reference Location	Ingestion	Mercury	0.024	mg/kg	4.8E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.1E-04	(mg/kg/day)	1.0E-04	(mg/kg/day)	1.1
				TEQ PCB	1.6E-6	mg/kg	3.3E-10	(mg/kg/day)	1.3E+05	$(mg/kg/day)^{-1}$	4.3E-05	7.7E-09	(mg/kg/day)	1.0E-09	(mg/kg/day)	7.7
				4,4'-DDD	0.002	mg/kg	3.1E-07	(mg/kg/day)	2.4E-01	$(mg/kg/day)^{-1}$	7.3E-08	7.1E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				4,4'-DDE	0.003	mg/kg	5.7E-07	(mg/kg/day)	3.4E-01	$(mg/kg/day)^{-1}$	1.9E-07	1.3E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				4,4'-DDT	0.001	mg/kg	2.6E-07	(mg/kg/day)	3.4E-01	$(mg/kg/day)^{-1}$	9.0E-08	6.2E-06	(mg/kg/day)	5.0E-04	(mg/kg/day)	0.01
			Exp. Route Total								4.3E-05					8.8
		Exposure Point Total									4.3E-05					8.8
	Exposure Medium Total										4.3E-05					8.8
Medium Total											4.3E-05					8.8
										Total of Receptor Risks Across All Media	4.3E-05				Total of Receptor Hazards Across All Media	8.8

TABLE 7.3.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS - CHILD SUBSISTENCE FISHER

SITE 3 - CAUSEWAY LANDFILL - REFERENCE LOCATION

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current
Receptor Population: Recreational Military Fisher
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Fish	Fish	Reference Location	Ingestion	Mercury	0.024	mg/kg	5.0E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	5.9E-06	(mg/kg/day)	1.0E-04	(mg/kg/day)	0.06
				TEQ PCB	1.6E-6	mg/kg	3.5E-11	(mg/kg/day)	1.3E+05	$(mg/kg/day)^{-1}$	4.5E-06	4.1E-10	(mg/kg/day)	1.0E-09	(mg/kg/day)	0.4
				4,4'-DDD	0.002	mg/kg	3.2E-08	(mg/kg/day)	2.4E-01	$(mg/kg/day)^{-1}$	7.7E-09	3.8E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				4,4'-DDE	0.003	mg/kg	6.0E-08	(mg/kg/day)	3.4E-01	$(mg/kg/day)^{-1}$	2.0E-08	7.0E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				4,4'-DDT	0.001	mg/kg	2.8E-08	(mg/kg/day)	3.4E-01	$(mg/kg/day)^{-1}$	9.5E-09	3.3E-07	(mg/kg/day)	5.0E-04	(mg/kg/day)	0.0007
			Exp. Route Total								4.6E-06					0.5
		Exposure Point Total									4.6E-06					0.5
	Exposure Medium Total										4.6E-06					0.5
Medium Total											4.6E-06					0.5
							Total of Receptor Risks Across All Media				4.6E-06	Total of Receptor Hazards Across All Media				0.5

TABLE 7.4.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS - ADULT RECREATIONAL CIVILIAN FISHER

SITE 3 - CAUSEWAY LANDFILL - REFERENCE LOCATION

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current
Receptor Population: Recreational Civilian Fisher
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Fish	Fish	Reference Location	Ingestion	Mercury	0.024	mg/kg	5.9E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	5.9E-06	(mg/kg/day)	1.0E-04	(mg/kg/day)	0.06
				TEQ PCB	1.6E-6	mg/kg	4.1E-10	(mg/kg/day)	1.3E+05	$(mg/kg/day)^{-1}$	5.3E-05	4.1E-10	(mg/kg/day)	1.0E-09	(mg/kg/day)	0.4
				4,4'-DDD	0.002	mg/kg	3.8E-07	(mg/kg/day)	2.4E-01	$(mg/kg/day)^{-1}$	9.0E-08	3.8E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				4,4'-DDE	0.003	mg/kg	7.0E-07	(mg/kg/day)	3.4E-01	$(mg/kg/day)^{-1}$	2.4E-07	7.0E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				4,4'-DDT	0.001	mg/kg	3.3E-07	(mg/kg/day)	3.4E-01	$(mg/kg/day)^{-1}$	1.1E-07	3.3E-07	(mg/kg/day)	5.0E-04	(mg/kg/day)	0.0007
			Exp. Route Total								5.3E-05					0.5
		Exposure Point Total									5.3E-05					0.5
	Exposure Medium Total										5.3E-05					0.5
Medium Total											5.3E-05					0.5
							Total of Receptor Risks Across All Media				5.3E-05	Total of Receptor Hazards Across All Media				0.5

TABLE 7.5.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS - ADULT SUBSISTENCE FISHER

SITE 3 - CAUSEWAY LANDFILL - REFERENCE LOCATION

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current
Receptor Population: Subsistence Fisher
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Fish	Fish	Reference Location	Ingestion	Mercury	0.024	mg/kg	4.8E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	4.8E-05	(mg/kg/day)	1.0E-04	(mg/kg/day)	0.5
				TEQ PCB	1.6E-6	mg/kg	3.3E-09	(mg/kg/day)	1.3E+05	$(mg/kg/day)^{-1}$	4.3E-04	3.3E-09	(mg/kg/day)	1.0E-09	(mg/kg/day)	3.3
				4,4'-DDD	0.002	mg/kg	3.1E-06	(mg/kg/day)	2.4E-01	$(mg/kg/day)^{-1}$	7.3E-07	3.1E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				4,4'-DDE	0.003	mg/kg	5.7E-06	(mg/kg/day)	3.4E-01	$(mg/kg/day)^{-1}$	1.9E-06	5.7E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				4,4'-DDT	0.001	mg/kg	2.6E-06	(mg/kg/day)	3.4E-01	$(mg/kg/day)^{-1}$	9.0E-07	2.6E-06	(mg/kg/day)	5.0E-04	(mg/kg/day)	0.005
			Exp. Route Total								4.3E-04					3.8
		Exposure Point Total									4.3E-04					3.8
	Exposure Medium Total										4.3E-04					3.8
Medium Total											4.3E-04					3.8
										Total of Receptor Risks Across All Media	4.3E-04				Total of Receptor Hazards Across All Media	3.8

TABLE 7.6.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS - USEPA REGION IV DEFAULT

SITE 3 - CAUSEWAY LANDFILL - REFERENCE LOCATION

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current
Receptor Population: USEPA Region IV Default
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Fish	Fish	Reference Location	Ingestion	Mercury	0.024	mg/kg	7.5E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.7E-05	(mg/kg/day)	1.0E-04	(mg/kg/day)	0.2
				TEQ PCB	1.6E-6	mg/kg	5.1E-10	(mg/kg/day)	1.3E+05	$(mg/kg/day)^{-1}$	6.7E-05	1.2E-09	(mg/kg/day)	1.0E-09	(mg/kg/day)	1.2
				4,4'-DDD	0.002	mg/kg	4.8E-07	(mg/kg/day)	2.4E-01	$(mg/kg/day)^{-1}$	1.1E-07	1.1E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				4,4'-DDE	0.003	mg/kg	8.9E-07	(mg/kg/day)	3.4E-01	$(mg/kg/day)^{-1}$	3.0E-07	2.1E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				4,4'-DDT	0.001	mg/kg	4.1E-07	(mg/kg/day)	3.4E-01	$(mg/kg/day)^{-1}$	1.4E-07	9.6E-07	(mg/kg/day)	5.0E-04	(mg/kg/day)	0.002
			Exp. Route Total								6.7E-05					1.4
		Exposure Point Total									6.7E-05					1.4
	Exposure Medium Total										6.7E-05					1.4
Medium Total											6.7E-05					1.4
										Total of Receptor Risks Across All Media	6.7E-05				Total of Receptor Hazards Across All Media	1.4

TABLE 9.1.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - CHILD RECREATIONAL FISHER

SITE 3 - CAUSEWAY LANDFILL - REFERENCE LOCATION

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current
Receptor Population: Recreational Fisher
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Fish	Fish	Reference Location	Mercury	- -	--	- -	--	- -	CNS	0.2	- -	--	0.2
			TEQ PCB	9E-06	--	- -	--	9E-06	NA	2	- -	--	2
			4,4'-DDD	2E-08	--	- -	--	2E-08	NA	--	- -	--	--
			4,4'-DDE	4E-08	--	- -	--	4E-08	NA	--	- -	--	--
			4,4'-DDT	2E-08	--	- -	--	2E-08	Liver	0.003	- -	--	0.003
			Chemical Total	9E-06	--	- -	--	9E-06		2	--	--	2
		Exposure Point Total						9E-06					2
	Exposure Medium Total							9E-06					2
Medium Total								9E-06					2
Receptor Total							Receptor Risk Total	9E-06				Receptor HI Total	2

Total CNS HI	0.2
Total Liver HI	0.003
Total NA	2

TABLE 9.2.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - CHILD SUBSISTENCE FISHER

SITE 3 - CAUSEWAY LANDFILL - REFERENCE LOCATION

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current
Receptor Population: Subsistence Fisher
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Fish	Fish	Reference Location	Mercury	- -	--	- -	--	- -	CNS	1	- -	--	1
			TEQ PCB	4E-05	--	- -	--	4E-05	NA	8	- -	--	8
			4,4'-DDD	7E-08	--	- -	--	7E-08	NA	--	- -	--	--
			4,4'-DDE	2E-07	--	- -	--	2E-07	NA	--	- -	--	--
			4,4'-DDT	9E-08	--	- -	--	9E-08	Liver	0.01	- -	--	0.01
			Chemical Total	4E-05	--	- -	--	4E-05		9	--	--	9
		Exposure Point Total						4E-05					9
	Exposure Medium Total							4E-05					9
Medium Total								4E-05					9
Receptor Total							Receptor Risk Total	4E-05				Receptor HI Total	9

Total CNS HI	1
Total Liver HI	0.01
Total NA	8

TABLE 9.3.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - ADULT RECREATIONAL MILITARY FISHER

SITE 3 - CAUSEWAY LANDFILL - REFERENCE LOCATION

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current
Receptor Population: Recreational Military Fisher
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Fish	Fish	Reference Location	Mercury	- -	--	- -	--	- -	CNS	0.06	- -	--	0.06
			TEQ PCB	5E-06	--	- -	--	5E-06	NA	0.4	- -	--	0.4
			4,4'-DDD	8E-09	--	- -	--	8E-09	NA	--	- -	--	--
			4,4'-DDE	2E-08	--	- -	--	2E-08	NA	--	- -	--	--
			4,4'-DDT	9E-09	--	- -	--	9E-09	Liver	0.0007	- -	--	0.0007
			Chemical Total	5E-06	--	- -	--	5E-06		0.5	--	--	0.5
		Exposure Point Total						5E-06					0.5
	Exposure Medium Total							5E-06					0.5
Medium Total								5E-06					0.5
Receptor Total							Receptor Risk Total	5E-06				Receptor HI Total	0.5

Total CNS HI	0.06
Total Liver HI	0.0007
Total NA	0.4

TABLE 9.4.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - ADULT RECREATIONAL CIVILIAN FISHER

SITE 3 - CAUSEWAY LANDFILL - REFERENCE LOCATION

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current
Receptor Population: Recreational Civilian Fisher
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Fish	Fish	Reference Location	Mercury	- -	--	- -	--	- -	CNS	0.06	- -	--	0.06
			TEQ PCB	5E-05	--	- -	--	5E-05	NA	0.4	- -	--	0.4
			4,4'-DDD	9E-08	--	- -	--	9E-08	NA	--	- -	--	--
			4,4'-DDE	2E-07	--	- -	--	2E-07	NA	--	- -	--	--
			4,4'-DDT	1E-07	--	- -	--	1E-07	Liver	0.0007	- -	--	0.0007
			Chemical Total	5E-05	--	- -	--	5E-05		0.5	--	--	0.5
		Exposure Point Total						5E-05					0.5
	Exposure Medium Total							5E-05					0.5
Medium Total								5E-05					0.5
Receptor Total							Receptor Risk Total	5E-05				Receptor HI Total	0.5

Total CNS HI	0.06
Total Liver HI	0.0007
Total NA	0.4

TABLE 9.5.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - ADULT SUBSISTENCE FISHER

SITE 3 - CAUSEWAY LANDFILL - REFERENCE LOCATION

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current
Receptor Population: Subsistence Fisher
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Fish	Fish	Reference Location	Mercury	- -	--	- -	--	- -	CNS	0.5	- -	--	0.5
			TEQ PCB	4E-04	--	- -	--	4E-04	NA	3	- -	--	3
			4,4'-DDD	7E-07	--	- -	--	7E-07	NA	--	- -	--	--
			4,4'-DDE	2E-06	--	- -	--	2E-06	NA	--	- -	--	--
			4,4'-DDT	9E-07	--	- -	--	9E-07	Liver	0.005	- -	--	0.005
			Chemical Total	4E-04	--	- -	--	4E-04		4	--	--	4
		Exposure Point Total						4E-04					4
	Exposure Medium Total							4E-04					4
Medium Total								4E-04					4
Receptor Total							Receptor Risk Total	4E-04				Receptor HI Total	4

Total CNS HI	0.5
Total Liver HI	0.005
Total NA	3

TABLE 9.6.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - USEPA REGION IV DEFAULT

SITE 3 - CAUSEWAY LANDFILL - REFERENCE LOCATION

MCRD PARRIS ISLAND, SOUTH CAROLINA

Scenario Timeframe: Current
Receptor Population: USEPA Region IV Default
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Fish	Fish	Reference Location	Mercury	- -	--	- -	--	- -	CNS	0.2	- -	--	0.2
			TEQ PCB	7E-05	--	- -	--	7E-05	NA	1	- -	--	1
			4,4'-DDD	1E-07	--	- -	--	1E-07	NA	--	- -	--	--
			4,4'-DDE	3E-07	--	- -	--	3E-07	NA	--	- -	--	--
			4,4'-DDT	1E-07	--	- -	--	1E-07	Liver	0.002	- -	--	0.002
			Chemical Total	7E-05	--	- -	--	7E-05		1	--	--	1
		Exposure Point Total						7E-05					1
	Exposure Medium Total							7E-05					1
Medium Total								7E-05					1
Receptor Total							Receptor Risk Total	7E-05				Receptor HI Total	1

Total CNS HI	0.2
Total Liver HI	0.002
Total NA	1

H-3 SAMPLE CALCULATIONS

CALCULATION WORKSHEET

CLIENT: MCRD PARRIS ISLAND, SOUTH CAROLINA		**JOB NUMBER:** 2380
SUBJECT: CALCULATION OF INTAKE/RISK FROM INCIDENTAL INGESTION OF FISH/SHELLFISH ADULT SUBSISTENCE FISHER		
BASED ON: USEPA, DEC. 1989		
BY: R. JUPIN	**CHECKED BY:**	**DATE:** 12/17/2009

PURPOSE: To estimate intake, carcinogenic and noncarcinogenic risks from ingestion of fish.

EQUATION:

$$IEX = \frac{CFfish \times IR \times EF \times ED \times FI}{BW \times AT}$$

Where:

IEX	=	estimated exposure intake (mg/kg/day)
CFfish	=	exposure point concentration in fish tissue(mg/kg)
IR	=	incidental soil ingestion rate (kg/meal)
EF	=	exposure frequency (meals/year)
ED	=	exposure duration (years)
FI	=	fraction ingested from contaminated source (unitless)
BW	=	body weight (kg)
AT	=	averaging time (days)
CSFo	=	oral carcinogenic slope factor ($(mg/kg/day)^{-1}$)
RfDo	=	oral noncarcinogenic reference dose (mg/kg/day)

RISKS:

ICLR (Carcinogens) = Intake (mg/kg/day) x CSFo $(mg/kg/day)^{-1}$

HQ (Noncarcinogens) = Intake (mg/kg/day) / RFDo (mg/kg/day)

ASSUMPTIONS:

CFfish	=	0.0037	mg/kg	Chemical: 4,4'-DDT
IR	=	0.1424	kg/meal	
EF	=	365	meals/year	
ED	=	70	years	
FI	=	1	unitless	
BW	=	70	kg	
ATc	=	25550	days	
ATnc	=	25550	days	
CSFo	=	3.4E-01	$(mg/kg/day)^{-1}$	
RfDo	=	5.0E-04	(mg/kg/day)	

CLIENT: MCRD PARRIS ISLAND, SOUTH CAROLINA		JOB NUMBER: 2380
SUBJECT: CALCULATION OF INTAKE/RISK FROM INCIDENTAL INGESTION OF FISH/SHELLFISH ADULT SUBSISTENCE FISHER		
BASED ON: USEPA, DEC. 1989		
BY: R. JUPIN	CHECKED BY:	DATE: 12/17/2009

EXAMPLE CARCINOGENIC CALCULATION

$$\text{IEXc} = \frac{0.0037 \text{ mg/kg} \times 0.1424 \text{ kg/meal} \times 365 \text{ meals/year} \times 70 \text{ years} \times 1}{70 \text{ kg} \times 25550 \text{ days}}$$

IEXc = 7.53E-06 mg/kg/day

ICLR = 7.53E-06 mg/kg/day x 3.40E-01 (mg/kg/day)-1 = Incremental Lifetime Cancer Risk

ICLR = 2.6E-06

EXAMPLE NONCARCINOGENIC CALCULATION

$$\text{IEXnc} = \frac{0.0037 \text{ mg/kg} \times 0.1424 \text{ kg/meal} \times 365 \text{ meals/year} \times 70 \text{ years} \times 1}{70 \text{ kg} \times 25550 \text{ days}}$$

IEXnc = 7.53E-06 mg/kg/day

HQ = 7.53E-06 mg/kg/day / 5.00E-04 (mg/kg/day) = Hazard Quotient

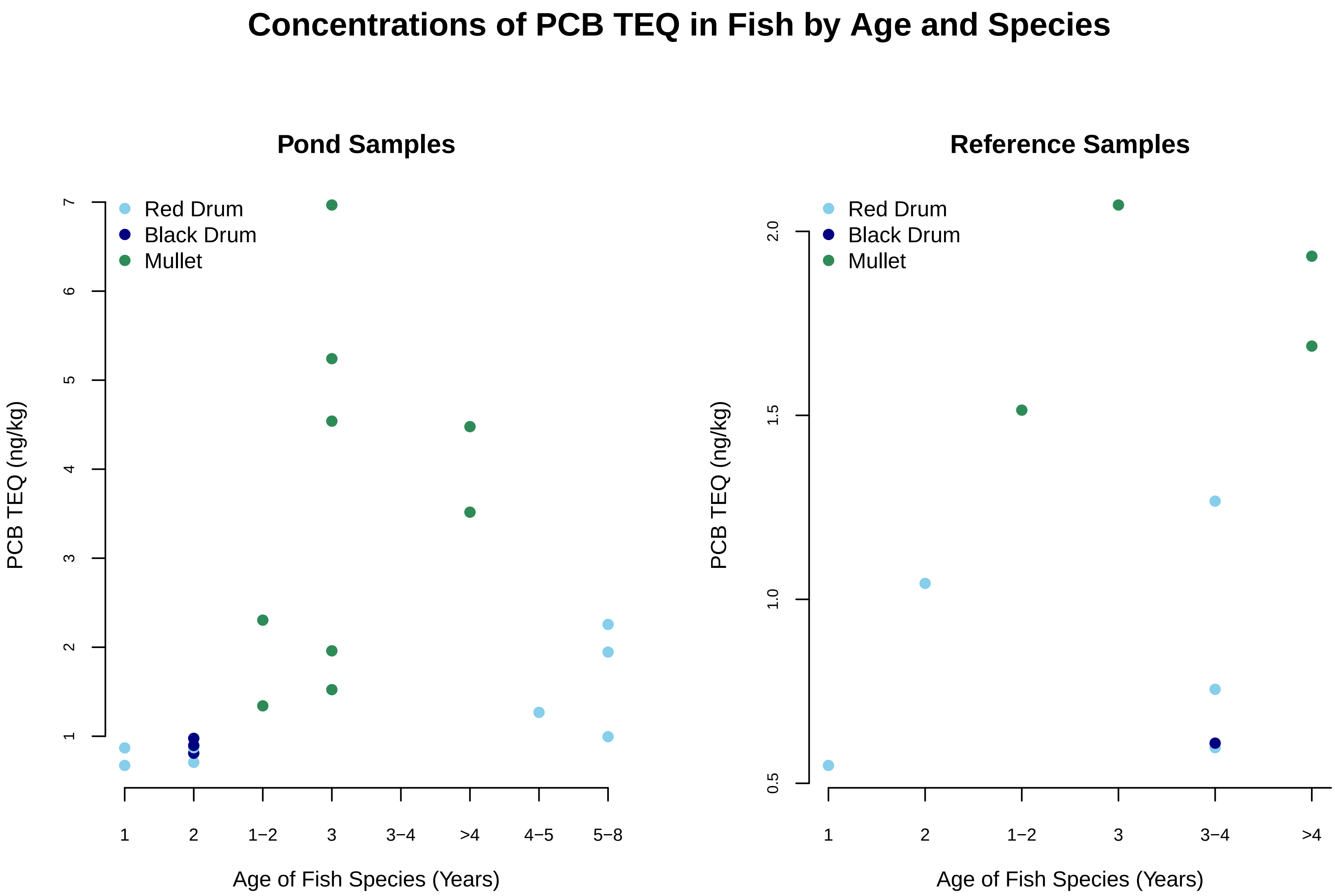
HQ = 1.5E-02

APPENDIX I

STATISTICAL COMPARISONS

Appendix I – Statistical Analysis

This appendix presents the results of four statistical comparisons of concentrations of PCBs found in fish samples. The first statistical analysis is a side by side graphical display of the concentration of PCB in the fish samples from the Site 3 pond and the reference samples by age and specie. The y-axis represents the concentration, the x-axis represents the age of the fish, and the specie is represented by a different color of symbol. The second analysis is a formal comparison of PCB concentrations in fish samples from the Site 3 pond to the reference samples. The third analysis, is a formal comparison of PCB concentrations in fish samples from Site 3 pond to the reference samples without outliers identified using Tukey's outlier method. The fourth statistical analysis, is formal comparison of PCB concentrations in Site3 pond fish samples to the reference samples by fish species. Each of the three formal statistical analyses was conducted on three data sets, lipid normalized concentrations, length normalized, and lipid and length normalized concentrations. The details of the four statistical analysis are presented below.


Concentrations of PCB TEQ in Fish by Age and Species
Pond Samples
Reference Samples
Red Drum
Black Drum
Mullet
PCB TEQ (ng/kg)
Age of Fish Species (Years)
1
2
3
4
5
6
7
0.5
1.0
1.5
2.0
1−2
3−4
>4
4−5
5−8

Comparison of Site Data to Background Data

This section describes the statistical methodologies used to compare PCB congener pond data with reference data to determine if the analytical results obtained from the samples represent site conditions or background/anthropogenic conditions. For the background comparison site pond lipid normalized values, length normalized values, and lipid and length normalized values were compared to reference lipid normalized values, length normalized values, and lipid and length normalized values.

For the statistical analyses the detection limit was used for non-detected concentrations. There were four red drum fish that exceeded the length and would not therefore have been returned to the pond and not eaten. The four samples that were removed are PAI-03-RD-03-03, PAI-03-RD-03-04, PAI-03-RD-04-01, and PAI-03-RD-RF-06.

The first step in comparing pond data with the reference data was to examine summary statistics, probability plots, and box plots. Probability plots are a useful first set for visually comparing two data sets in a single graph. The probability plot is useful because it provides a direct visual comparison of the two data sets. If the site and background distributions were exactly identical, the plotted values would lie on a straight line through the origin. Deviations from this line show the differences between the two distributions. If the site and background distributions are similar the scattering of the two data sets will be mixed. If there is grouping of the two data sets then data sets are most likely different. Box plots show the central tendency, degree of symmetry, range of variation, and potential outliers of a data set. The data set is shown as a rectangular box that represents the middle 50 percent of the data. The upper value of the box (75^{th} percentile) and the lower value of the box (25^{th} percentile) define the top and bottom of the rectangle respectively. The median is represented by the middle line in the box. Box and whisker plots for the same analyte in the two data sets were plotted on the same graph. Outliers are identified by using Tukey's rule which identifies data points greater than the 75^{th} percentile plus 1.5 times the middle 50 percent of the data as outliers. The figures showing the graphical displays of the data appear at the end of this section.

After inspection of the graphical displays of the data sets the outliers identified using Tukey's rule were removed from the data set. After the outliers were removed two methods were conducted to determine if the pond concentrations exceed the reference concentrations. The first method involved comparing the maximum pond concentration to twice the reference average. If the maximum pond concentration exceeded twice the reference average then it was concluded that the pond concentrations are not representative of background conditions. If the maximum pond concentration did not exceed twice the reference average concentration than it was concluded that the pond concentrations are representative of background conditions. The second method was a statistical hypothesis test comparing the average of the pond and reference concentrations. The null hypothesis was that the average pond concentrations are equal to the average reference concentrations while the alternative hypothesis was that the average pond concentrations exceed the average reference concentrations. The hypothesis tests were conducted using a 0.05 level of significance(p-value less than 0.05). The p-value can be thought of as the credibility of the null hypothesis when the p-value is greater than 0.05 there is enough credibility to believe the null hypothesis, when the p-value is less than 0.05 there is not enough credibility to believe the null hypothesis.

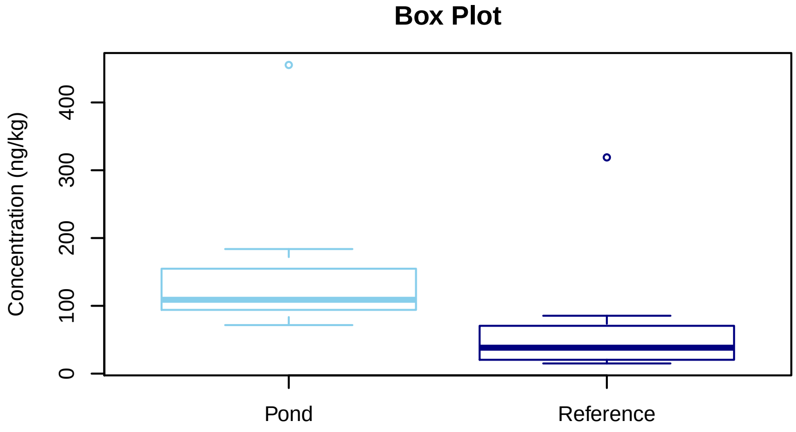
Table 1, 2, and 3 display the results of the two comparisons for the lipid normalized, length normalized, and lipid and length normalized PCB congener data.

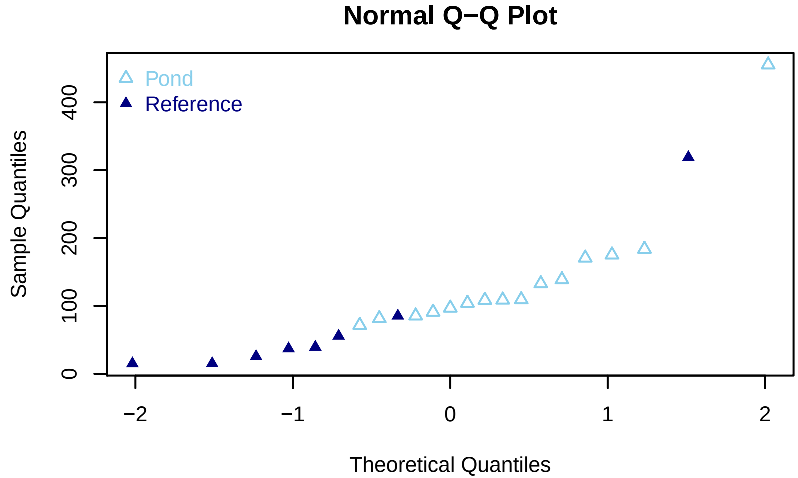
Table 1 Lipid Normalized Comparison					
PCB Congener	Method 1 Comparison Pond Maximum to Twice Reference Average			Method 2 Comparison Hypothesis Test	
	Maximum Pond Concentration (ng/kg)	Average Reference Concentration (ng/kg)	Conclusion	P-Value	Conclusion
PCB-118	871.	124	Pond does not represent Background	8.60E-6	Pond does not represent Background
PCB-105	184	39.1	Pond does not represent Background	3.40E-5	Pond does not represent Background
PCB-156/157	94.9	10.0	Pond does not represent Background	1.30E-5	Pond does not represent Background
PCB-167	54.5	7.4	Pond does not represent Background	1.30E-5	Pond does not represent Background
PCB-169	27.5	3.3	Pond does not represent Background	0.025	Pond does not represent Background
PCB-77	17.9	6.4	Pond does not represent Background	5.9E-4	Pond does not represent Background
PCB-81	15.8	3.0	Pond does not represent Background	0.2	Pond represents Background
PCB-126	14.2	5.5	Pond does not represent Background	0.07	Pond represents Background
PCB-189	12	1.6	Pond does not represent Background	4.90E-6	Pond does not represent Background
PCB-114	11.4	3.9	Pond does not represent Background	1.2E-3	Pond does not represent Background
PCB-123	10.2	3.5	Pond does not represent Background	5.8E-4	Pond does not represent Background
TEQ PCB - Full DL	3.4	0.67	Pond does not represent Background	0.041	Pond does not represent Background

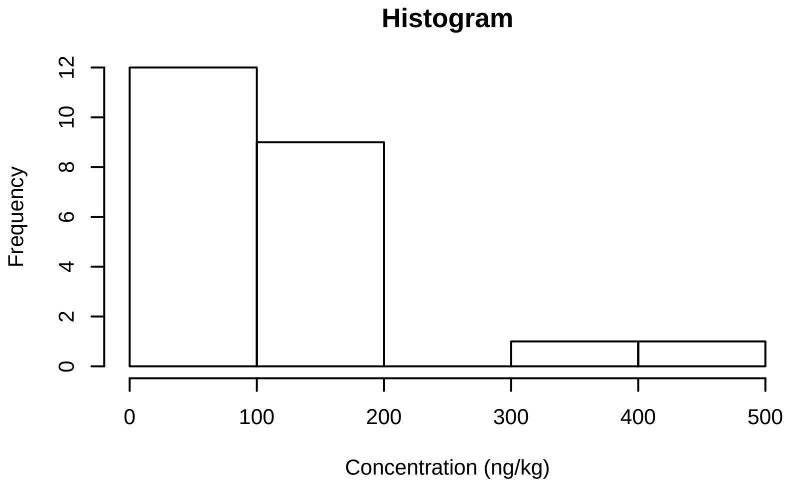
Table 2 Length Normalized Comparison					
PCB Congener	Method 1 Comparison Pond Maximum to Twice Reference Average			Method 2 Comparison Hypothesis Test	
	Maximum Pond Concentration (ng/kg)	Average Reference Concentration (ng/kg)	Conclusion	P-Value	Conclusion
PCB-118	95.4	11.2	Pond does not represent Background	0.066	Pond represents Background
PCB-105	19.5	3.3	Pond does not represent Background	0.12	Pond represents Background
PCB-156/157	12.6	1.3	Pond does not represent Background	0.05	Pond does not represent Background
PCB-167	10.2	0.66	Pond does not represent Background	0.038	Pond does not represent Background
PCB-189	2.5	0.063	Pond does not represent Background	0.0019	Pond does not represent Background
PCB-77	2.4	0.35	Pond does not represent Background	0.27	Pond represents Background
PCB-114	1.2	0.28	Pond does not represent Background	0.36	Pond represents Background
PCB-126	1.1	0.30	Pond does not represent Background	0.41	Pond represents Background
PCB-123	1.1	0.24	Pond does not represent Background	0.32	Pond represents Background
PCB-169	0.39	0.13	Pond does not represent Background	0.00081	Pond does not represent Background
PCB-81	0.31	0.15	Pond does not represent Background	0.27	Pond represents Background
TEQ PCB - Full DL	0.13	0.034	Pond does not represent Background	0.34	Pond represents Background

Table 3 Lipid and Length Normalized Comparison					
PCB Congener	Method 1 Comparison Pond Maximum to Twice Reference Average			Method 2 Comparison Hypothesis Test	
	Maximum Pond Concentration (ng/kg)	Average Reference Concentration (ng/kg)	Conclusion	P-Value	Conclusion
PCB-118	16.75054	3.683985	Pond does not represent Background	8.60E-06	Pond does not represent Background
PCB-105	3.499369	1.180523	Pond does not represent Background	0.0011	Pond does not represent Background
PCB-156/157	1.893939	0.290709	Pond does not represent Background	1.30E-05	Pond does not represent Background
PCB-167	1.412338	0.214956	Pond does not represent Background	1.30E-05	Pond does not represent Background
PCB-189	0.586192	0.094993	Pond does not represent Background	0.041	Pond does not represent Background
PCB-77	0.510719	0.147832	Pond does not represent Background	0.13	Pond represents Background
PCB-114	0.431116	0.111529	Pond does not represent Background	0.0079	Pond does not represent Background
PCB-126	0.426313	0.085809	Pond does not represent Background	0.31	Pond represents Background
PCB-123	0.384615	0.099315	Pond does not represent Background	0.0037	Pond does not represent Background
PCB-169	0.353878	0.137932	Pond does not represent Background	0.00025	Pond does not represent Background
PCB-81	0.286255	0.043508	Pond does not represent Background	4.90E-06	Pond does not represent Background
TEQ PCB - Full DL	0.068703	0.017977	Pond does not represent Background	0.083	Pond represents Background

Lipid Normalized
PCB−105





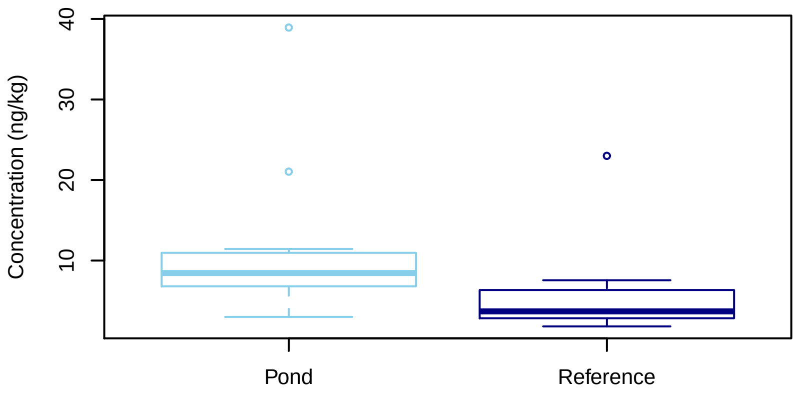


Summary Statistics

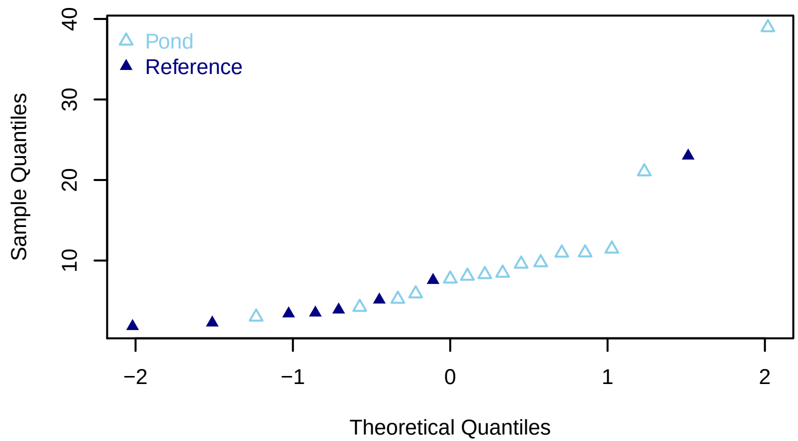
	Pond	**Reference**
Minimum	71.61	15.05
25th Percentile	94.04	22.99
Median	108.9	38.27
Mean	141	74.06
75th Percentile	154.8	63.15
Maximum	455.3	319

Lipid Normalized
PCB−114

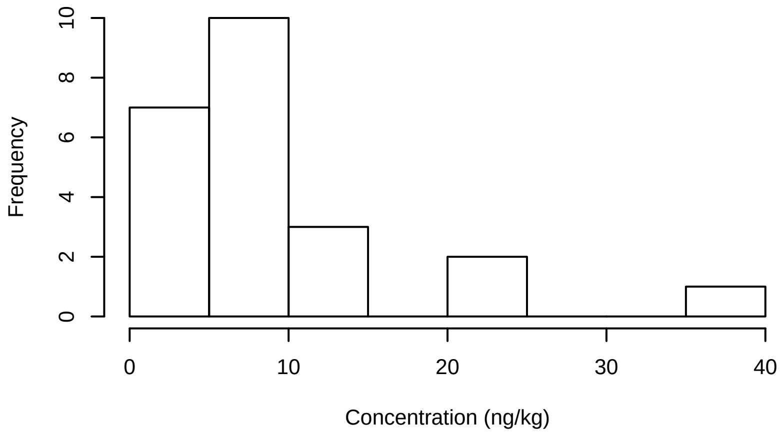
Box Plot



Normal Q−Q Plot



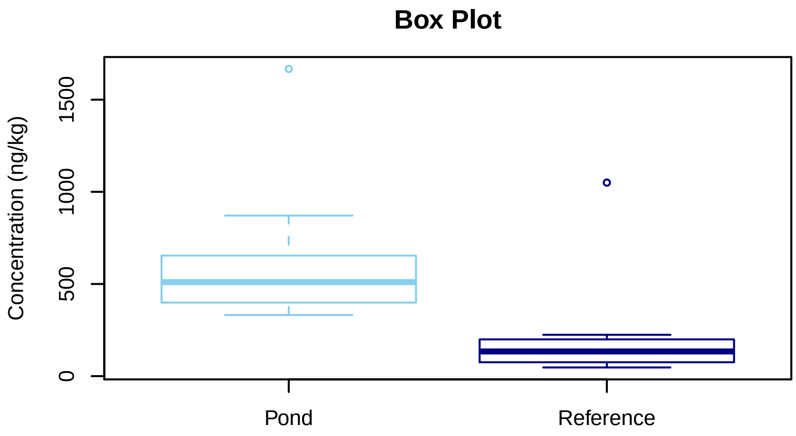
Histogram

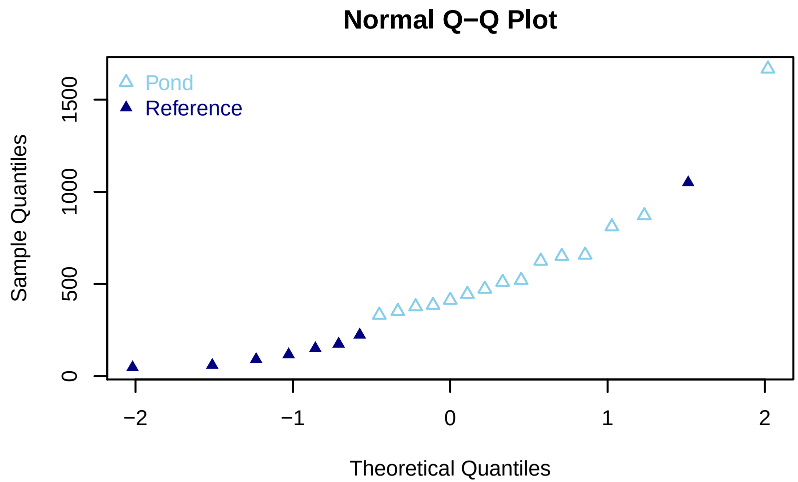


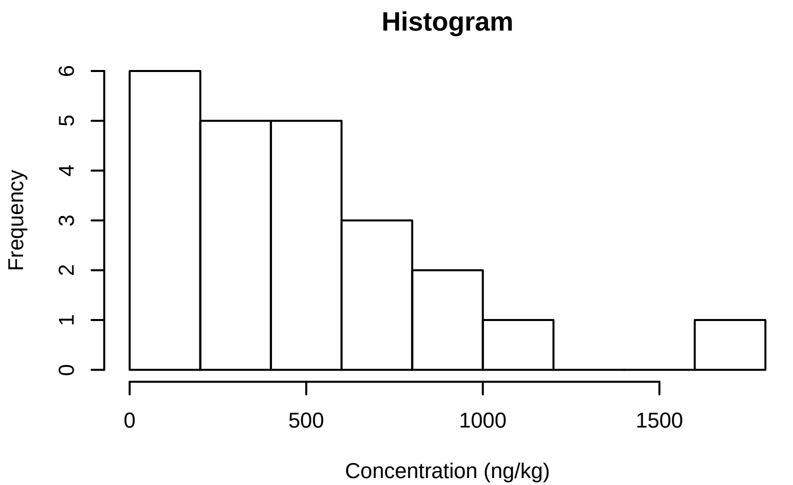
Summary Statistics

	Pond	**Reference**
Minimum	2.996	1.831
25th Percentile	6.807	3.122
Median	8.447	3.696
Mean	10.9	6.322
75th Percentile	10.96	5.73
Maximum	38.93	23

Lipid Normalized
PCB−118





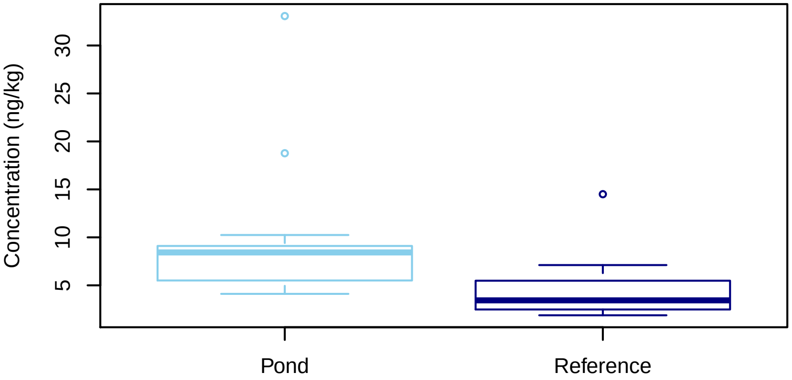


Summary Statistics

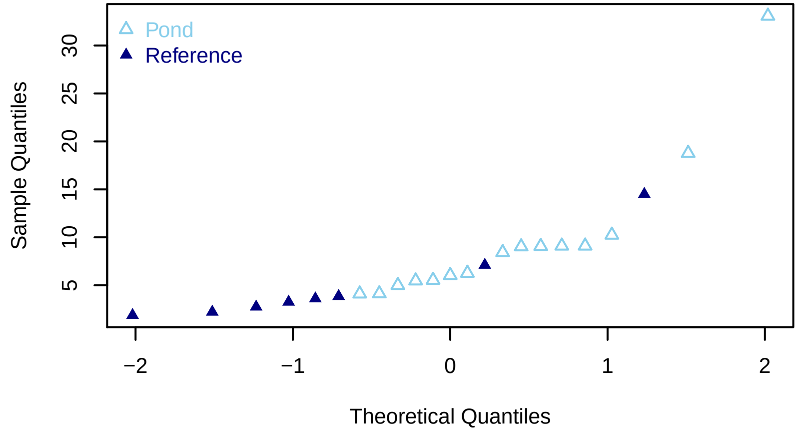
	Pond	Reference
Minimum	331.6	47.2
25th Percentile	399	83.27
Median	510.3	134
Mean	606	239.4
75th Percentile	654.3	187.2
Maximum	1667	1050

Lipid Normalized
PCB−123

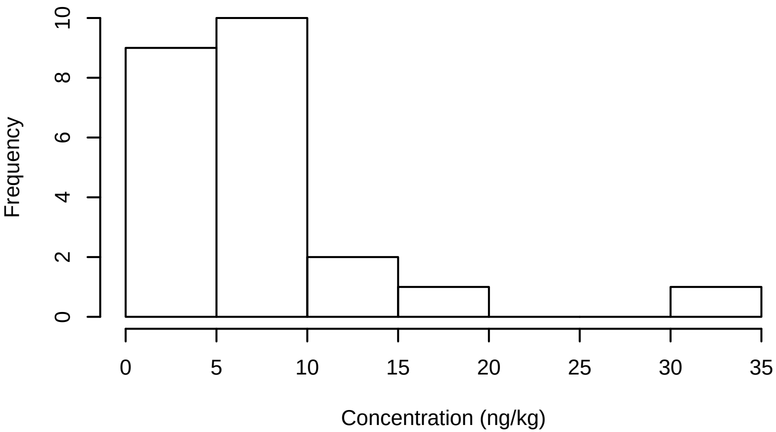
Box Plot



Normal Q−Q Plot



Histogram

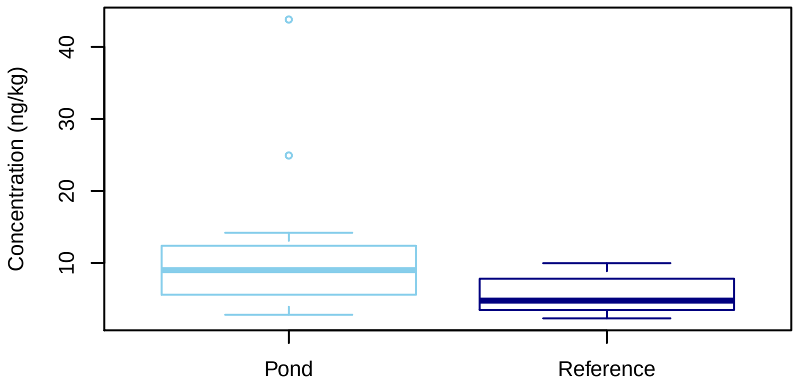


Summary Statistics

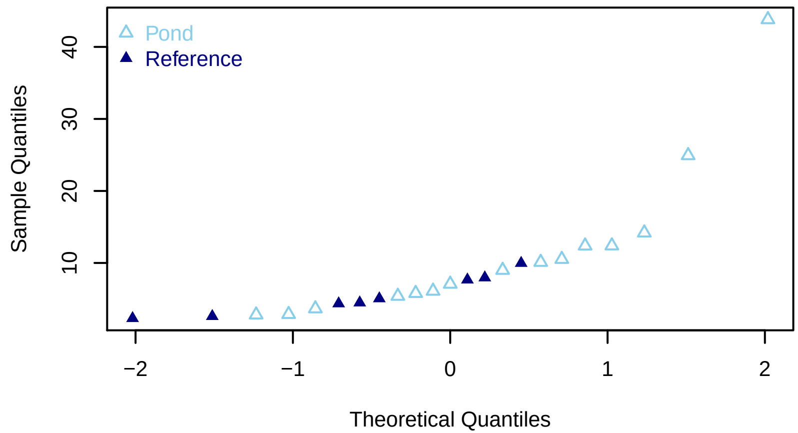
	Pond	**Reference**
Minimum	4.111	1.881
25th Percentile	5.507	2.619
Median	8.429	3.435
Mean	9.559	4.899
75th Percentile	9.106	4.671
Maximum	33.07	14.5

Lipid Normalized
PCB−126

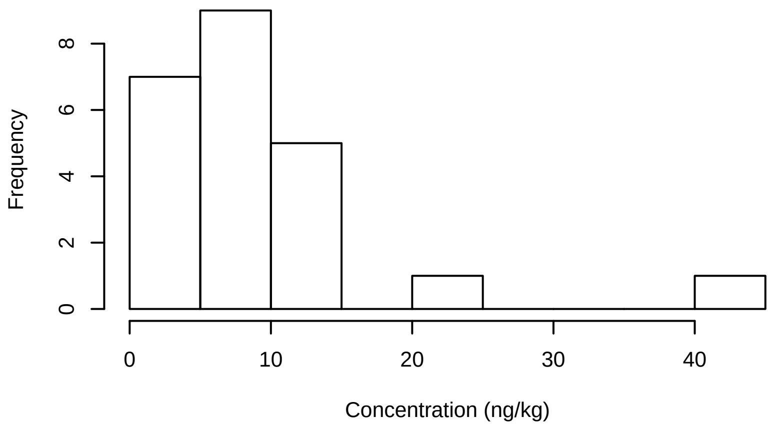
Box Plot



Normal Q−Q Plot



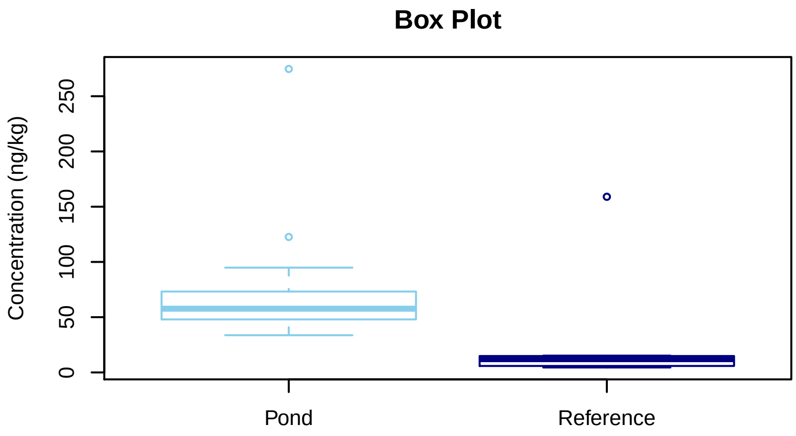
Histogram

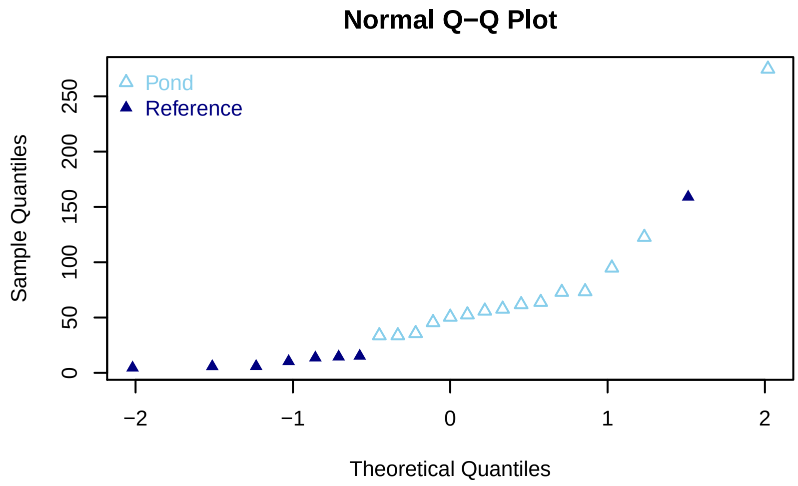


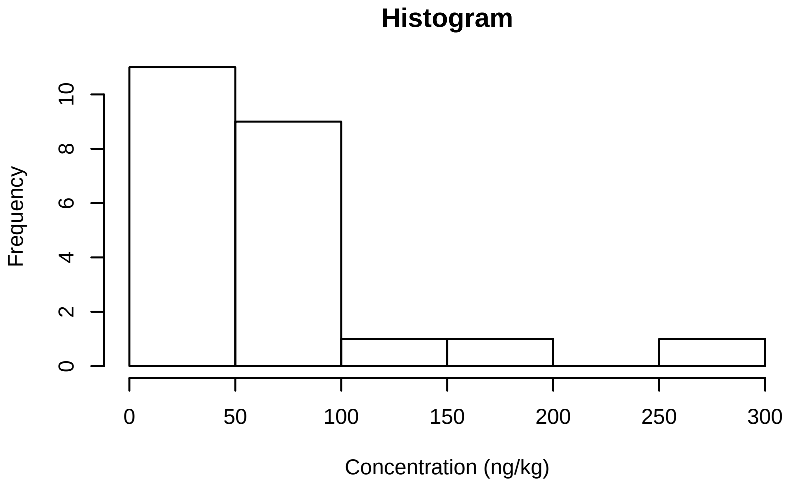
Summary Statistics

	Pond	**Reference**
Minimum	2.804	2.309
25th Percentile	5.592	3.916
Median	9	4.769
Mean	11.4	5.549
75th Percentile	12.39	7.74
Maximum	43.8	9.97

Lipid Normalized
PCB−156/157



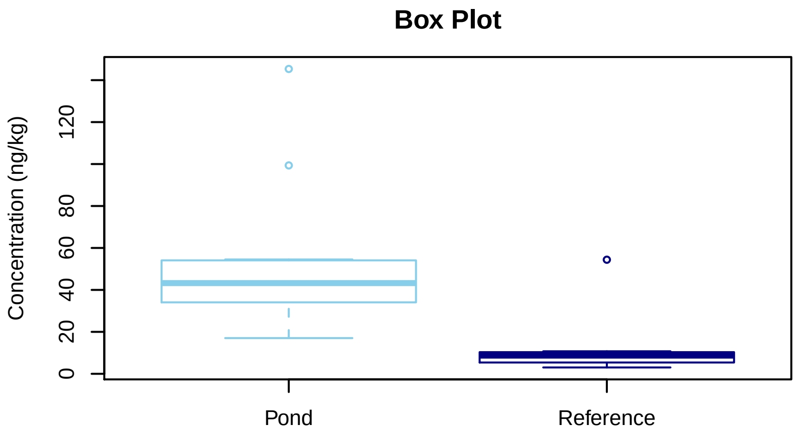


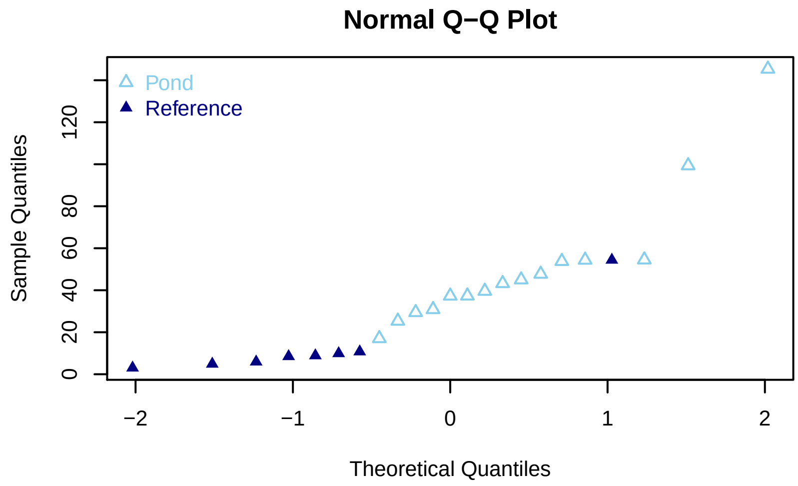


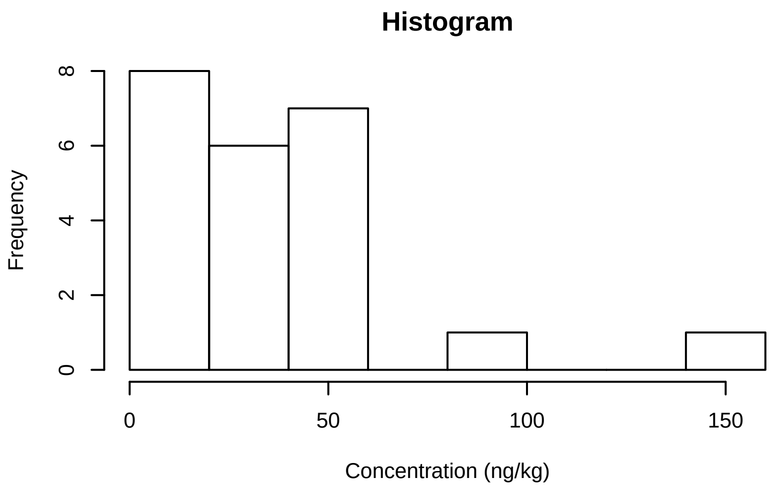
Summary Statistics

	Pond	Reference
Minimum	33.68	4.52
25th Percentile	47.99	5.878
Median	57.68	12
Mean	75.3	28.62
75th Percentile	73.22	14.68
Maximum	274.7	159

Lipid Normalized
PCB−167



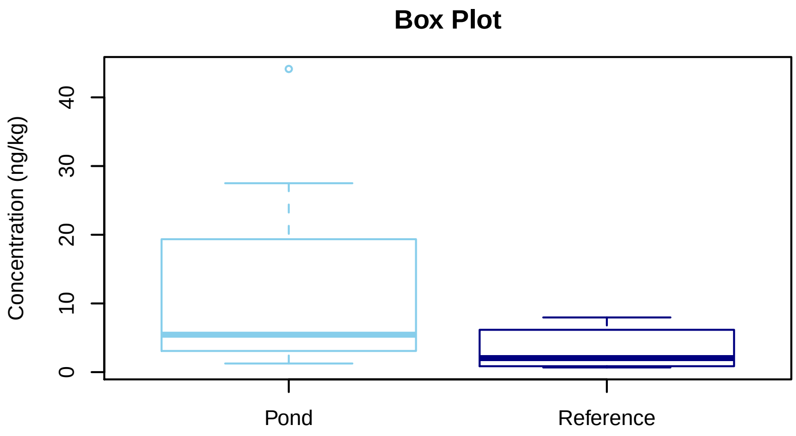


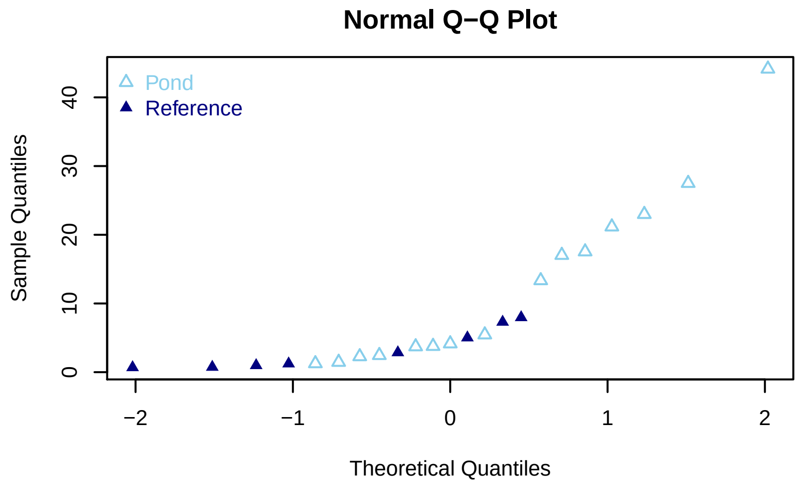


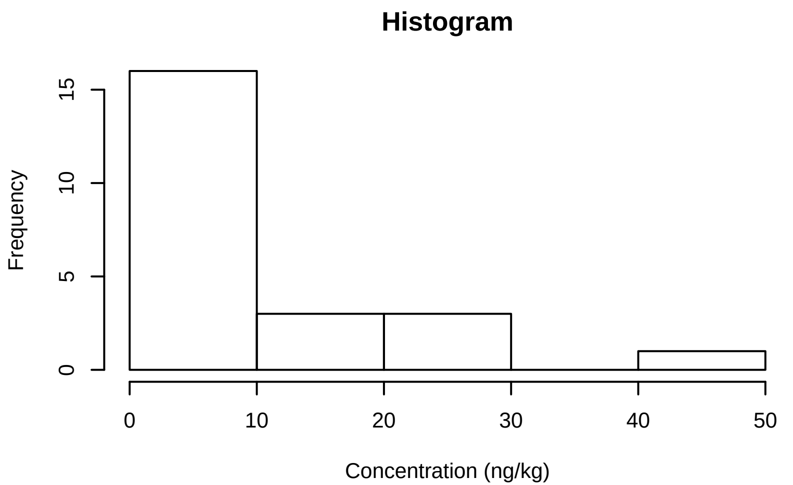
Summary Statistics

	Pond	Reference
Minimum	17.03	3.036
25th Percentile	34.07	5.657
Median	43.24	8.676
Mean	50.67	13.28
75th Percentile	54.08	10.1
Maximum	145.3	54.4

Lipid Normalized
PCB−169



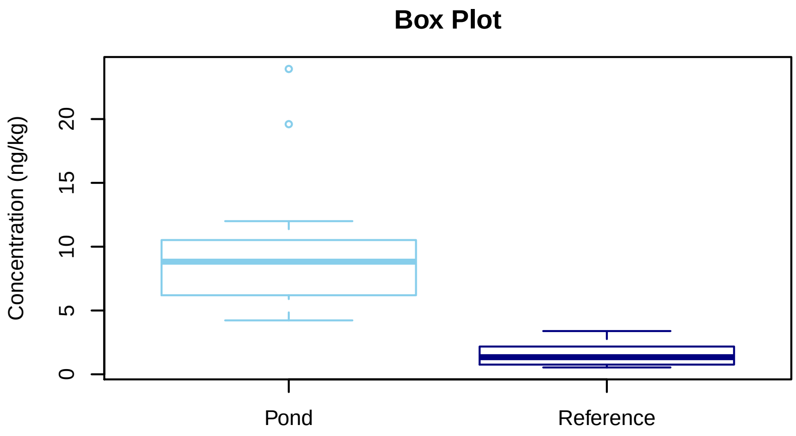


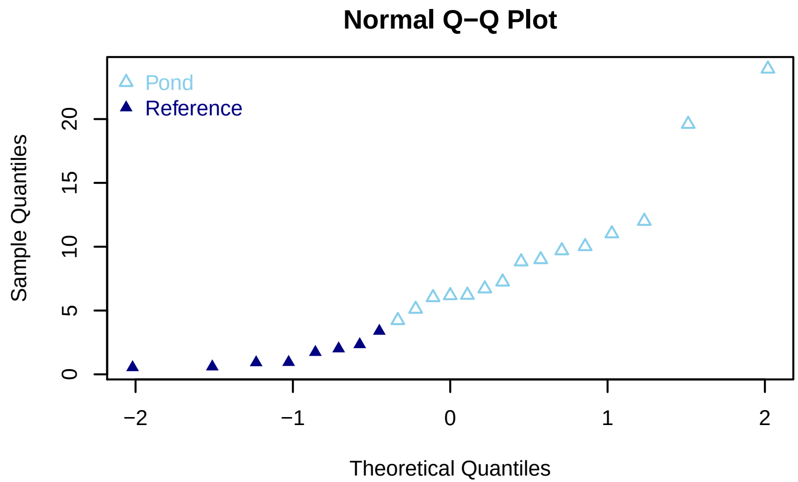


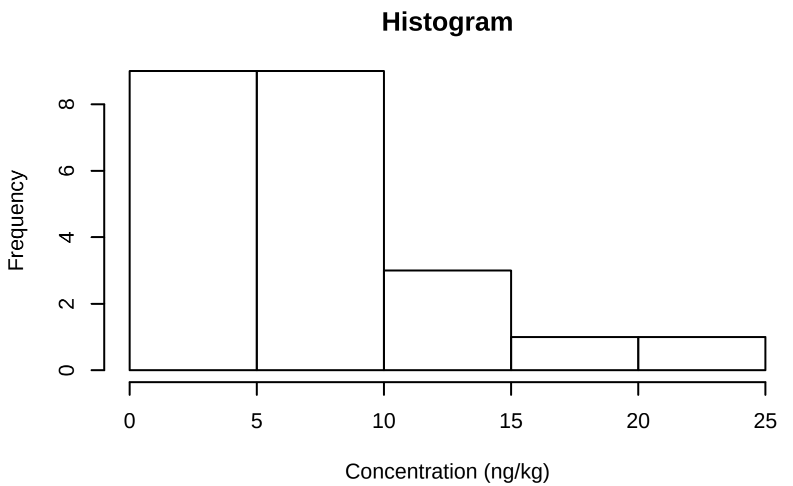
Summary Statistics

	Pond	Reference
Minimum	1.256	0.6857
25th Percentile	3.085	0.9232
Median	5.45	2.043
Mean	12.55	3.348
75th Percentile	19.35	5.591
Maximum	44.13	7.963

Lipid Normalized
PCB−189





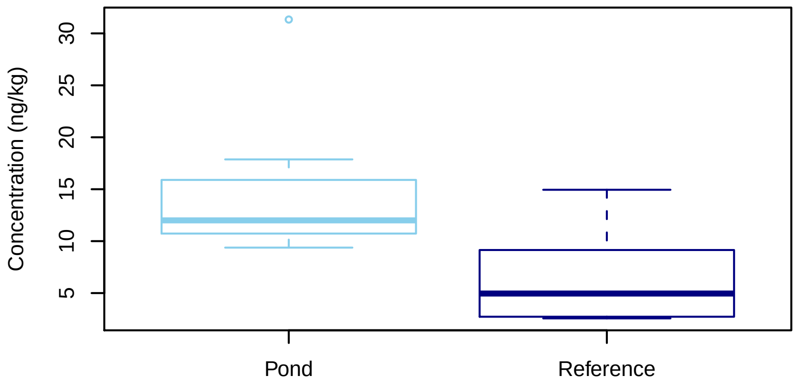


Summary Statistics

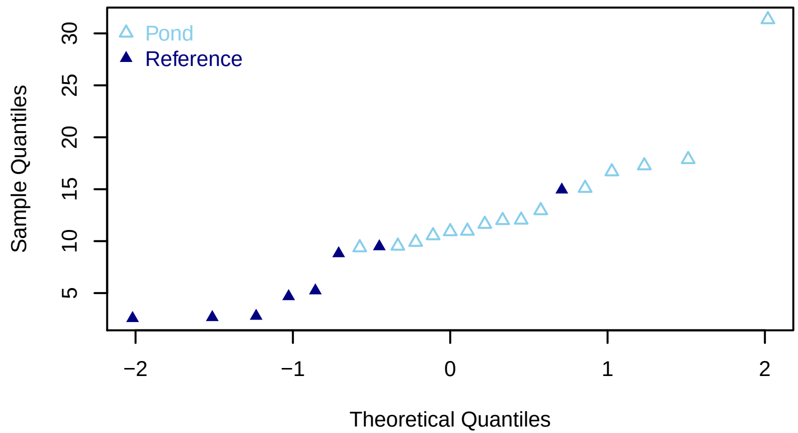
	Pond	Reference
Minimum	4.226	0.5382
25th Percentile	6.193	0.8435
Median	8.824	1.34
Mean	9.718	1.56
75th Percentile	10.52	2.093
Maximum	23.93	3.389

Lipid Normalized
PCB−77

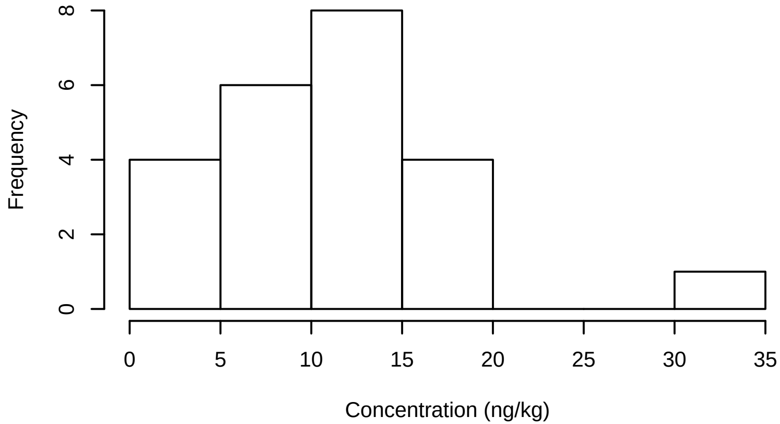
Box Plot



Normal Q−Q Plot



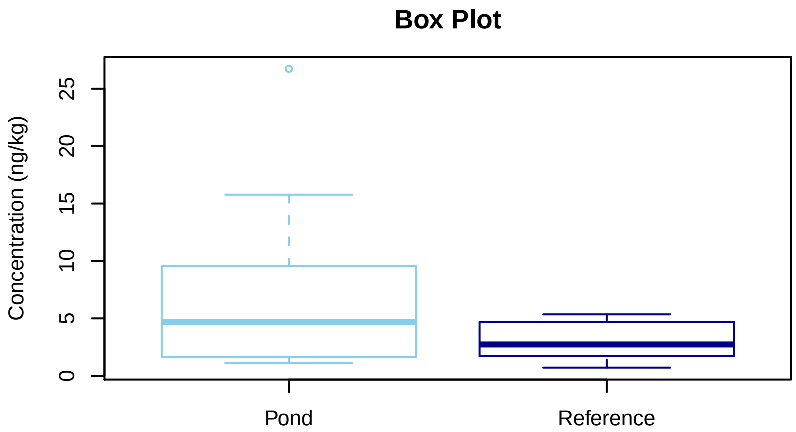
Histogram

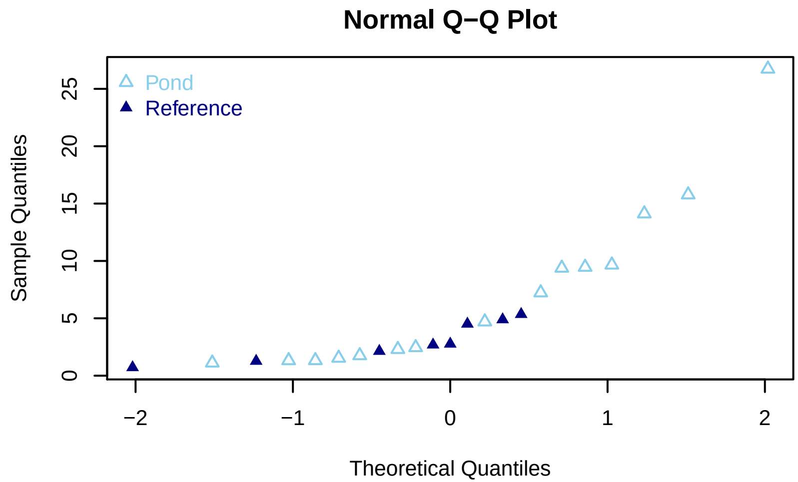


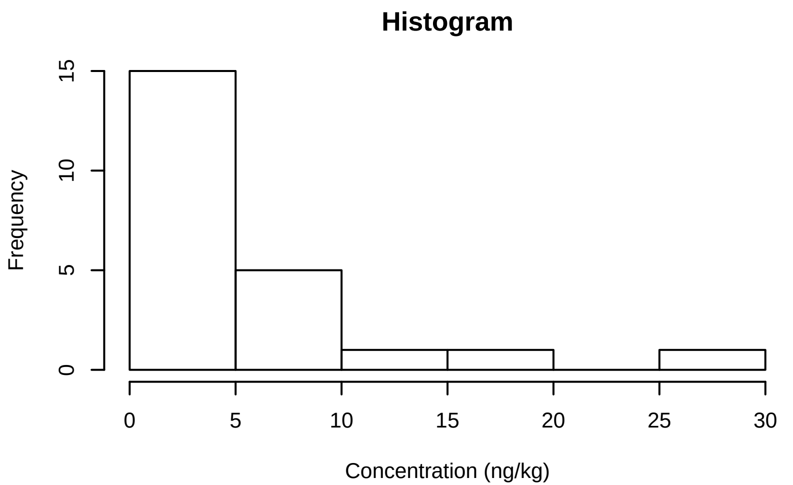
Summary Statistics

	Pond	Reference
Minimum	9.378	2.568
25th Percentile	10.73	2.755
Median	12	4.956
Mean	13.88	6.395
75th Percentile	15.89	8.978
Maximum	31.33	14.95

Lipid Normalized
PCB−81





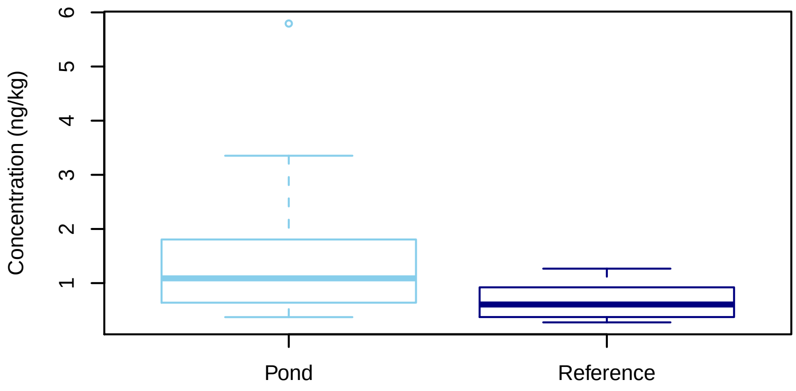


Summary Statistics

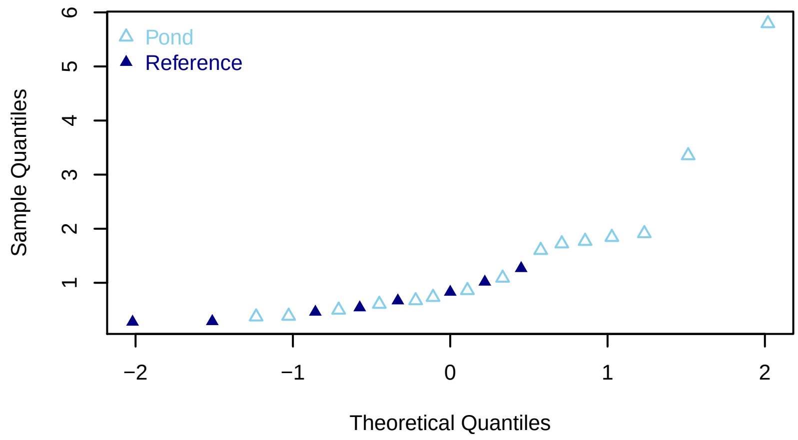
	Pond	Reference
Minimum	1.116	0.7153
25th Percentile	1.645	1.92
Median	4.7	2.729
Mean	7.258	3.042
75th Percentile	9.559	4.605
Maximum	26.73	5.352

Lipid Normalized
TEQ PCB − Full DL

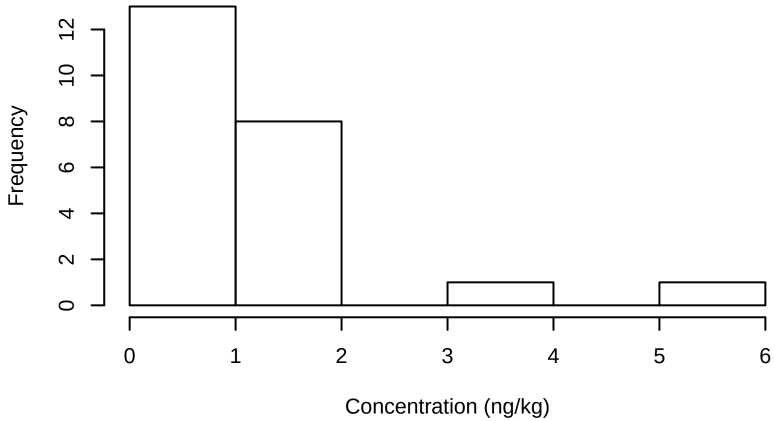
Box Plot



Normal Q−Q Plot



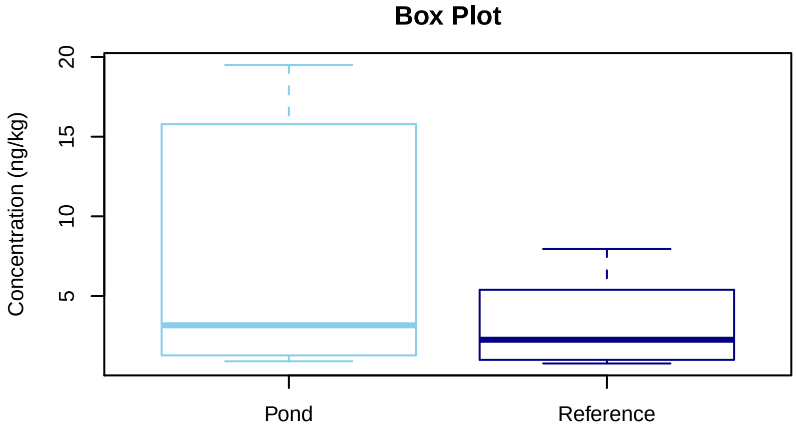
Histogram

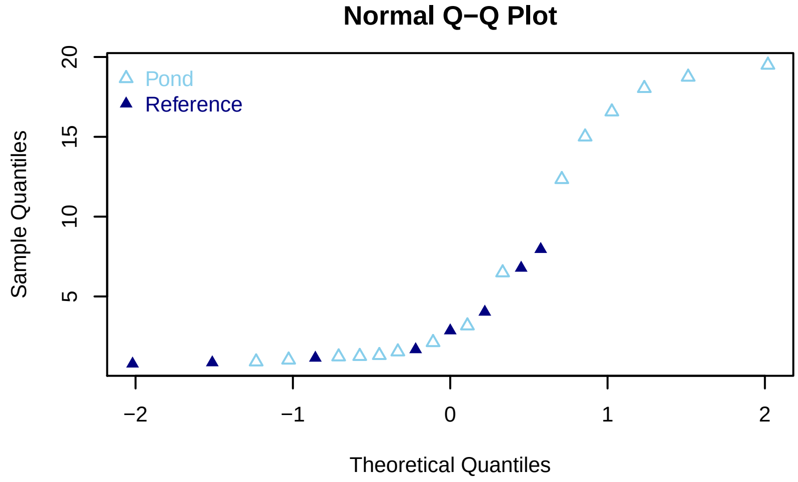


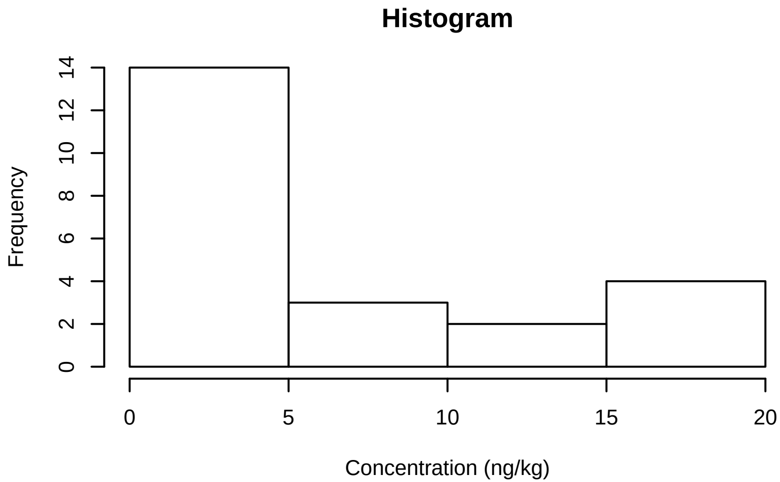
Summary Statistics

	Pond	Reference
Minimum	0.3716	0.2753
25th Percentile	0.6386	0.4167
Median	1.088	0.6052
Mean	1.547	0.668
75th Percentile	1.806	0.8756
Maximum	5.794	1.267

Length Normalized
PCB−105



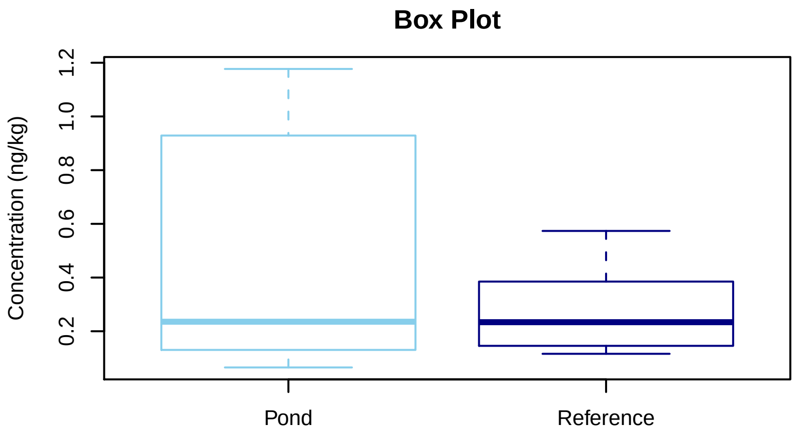


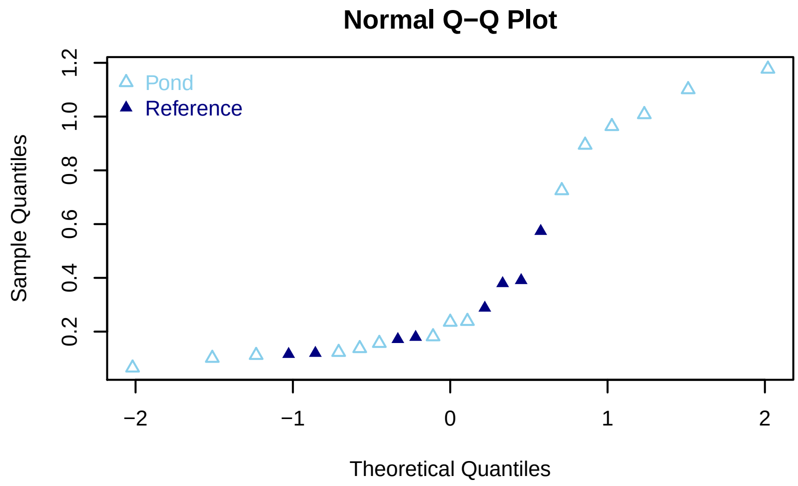


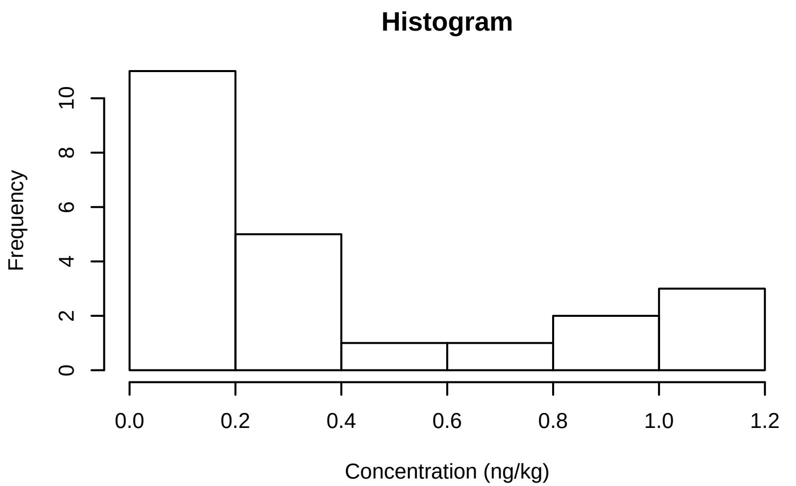
Summary Statistics

	Pond	Reference
Minimum	0.9098	0.7771
25th Percentile	1.282	1.072
Median	3.167	2.267
Mean	7.948	3.259
75th Percentile	15.79	4.715
Maximum	19.5	7.955

Length Normalized
PCB−114



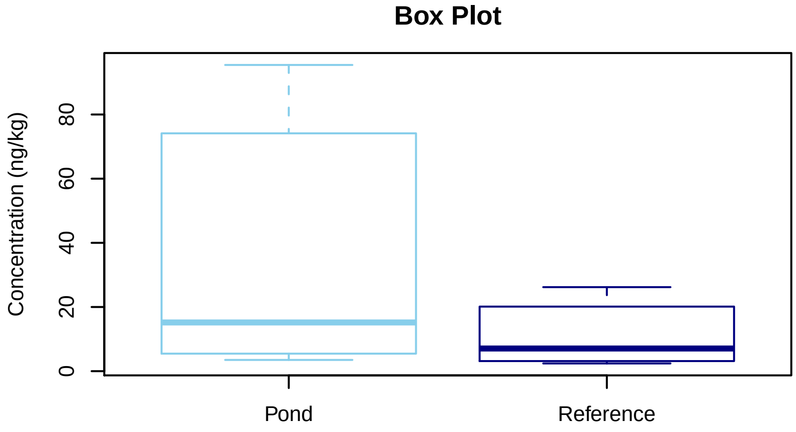


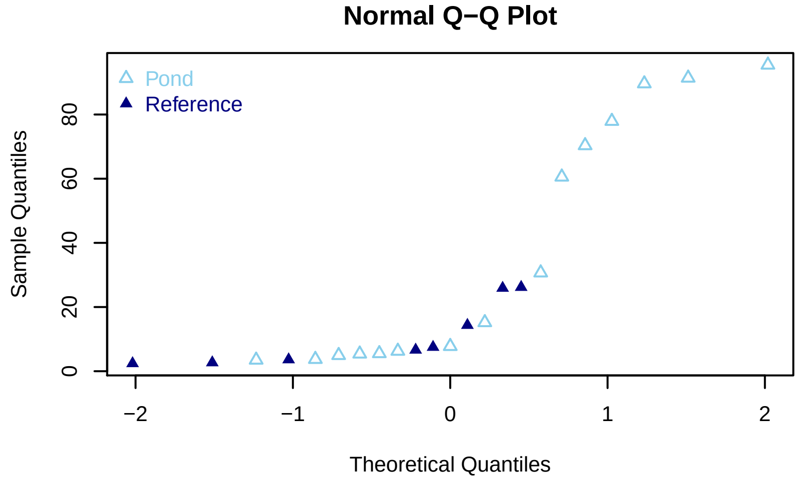


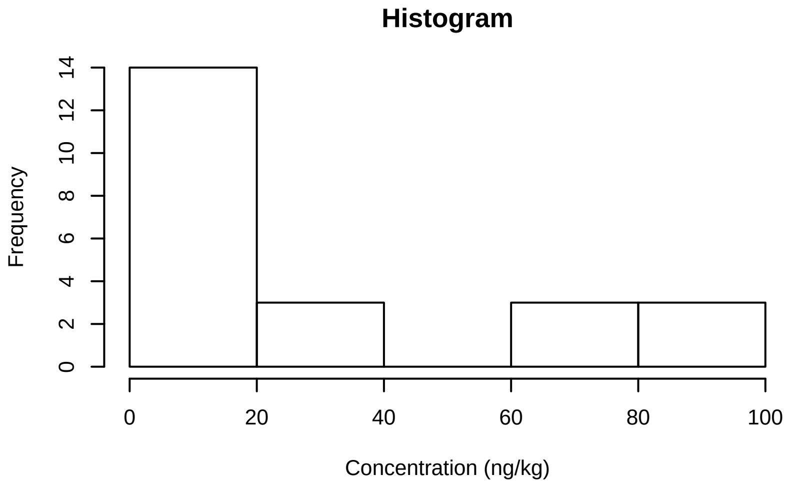
Summary Statistics

	Pond	Reference
Minimum	0.06519	0.1159
25th Percentile	0.1305	0.1585
Median	0.2354	0.2337
Mean	0.4813	0.2772
75th Percentile	0.9289	0.3821
Maximum	1.177	0.5736

Length Normalized
PCB−118



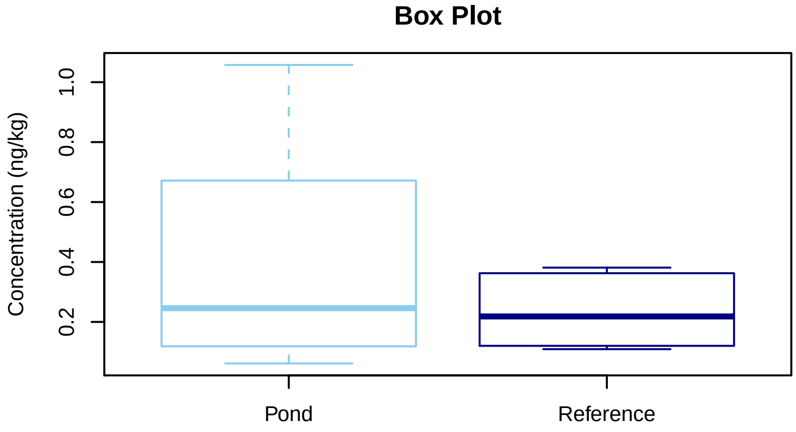


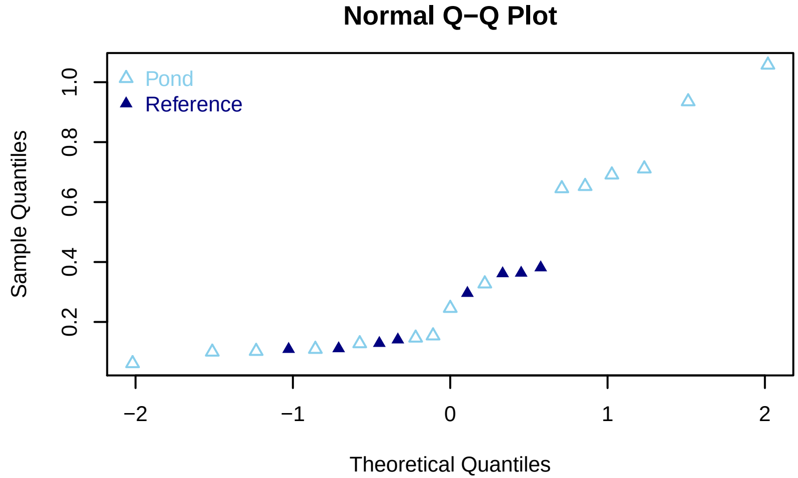


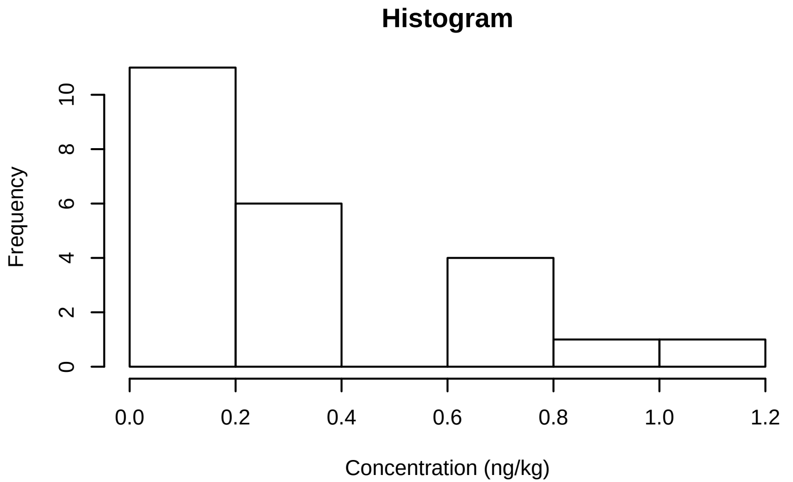
Summary Statistics

	Pond	Reference
Minimum	3.504	2.413
25th Percentile	5.465	3.383
Median	15.19	7.066
Mean	37.88	11.16
75th Percentile	74.13	17.24
Maximum	95.44	26.18

Length Normalized
PCB−123



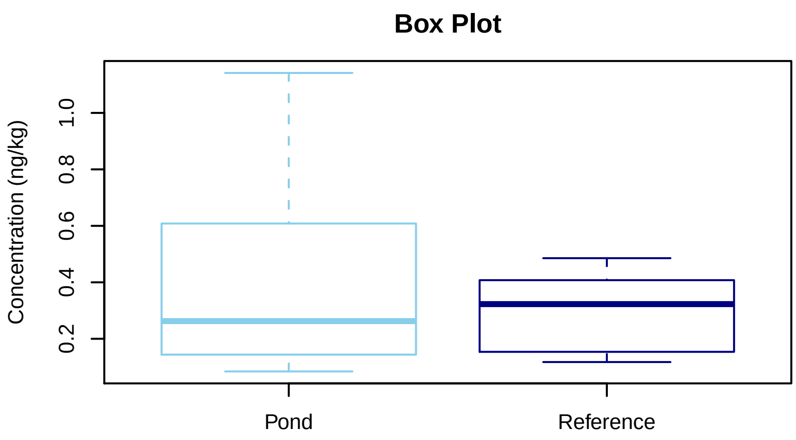


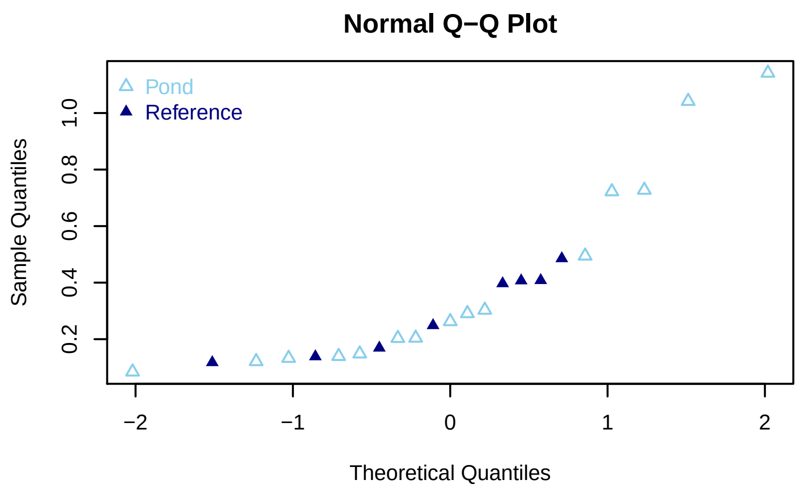


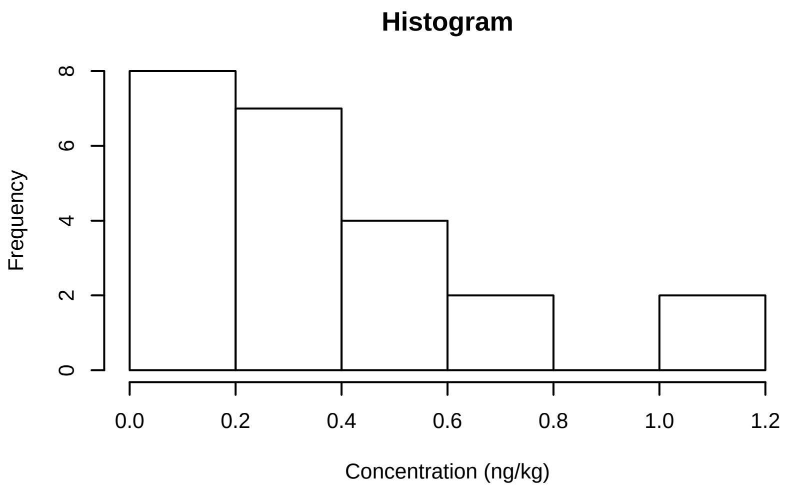
Summary Statistics

	Pond	**Reference**
Minimum	0.06151	0.1091
25th Percentile	0.1186	0.1246
Median	0.2458	0.2183
Mean	0.4045	0.2366
75th Percentile	0.6717	0.362
Maximum	1.057	0.3812

Length Normalized
PCB−126



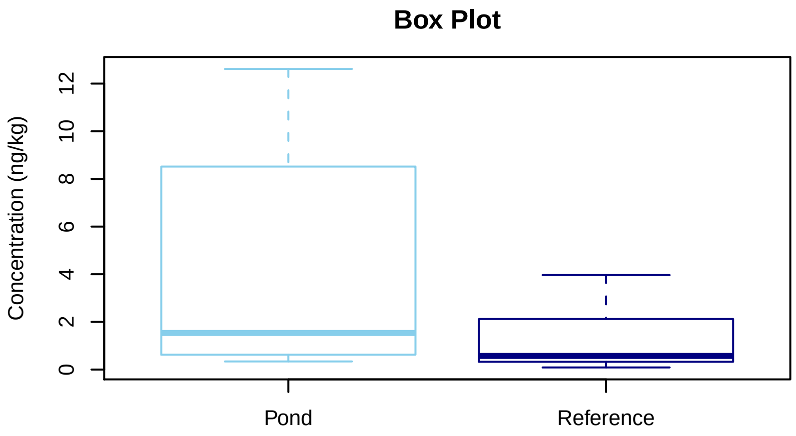


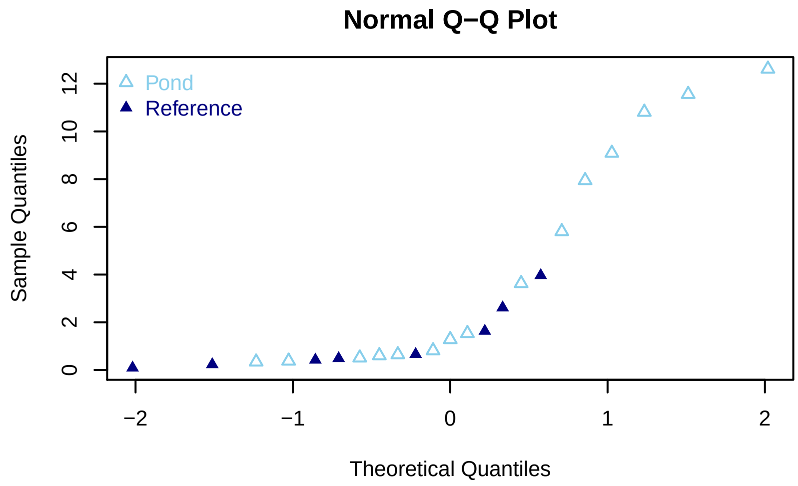


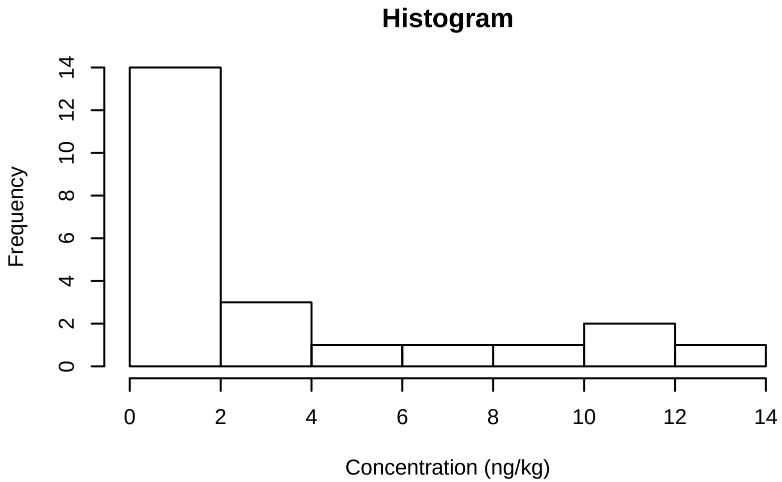
Summary Statistics

	Pond	Reference
Minimum	0.08435	0.1176
25th Percentile	0.1439	0.1614
Median	0.2625	0.3228
Mean	0.4011	0.2964
75th Percentile	0.6083	0.4072
Maximum	1.141	0.4854

Length Normalized
PCB−156/157





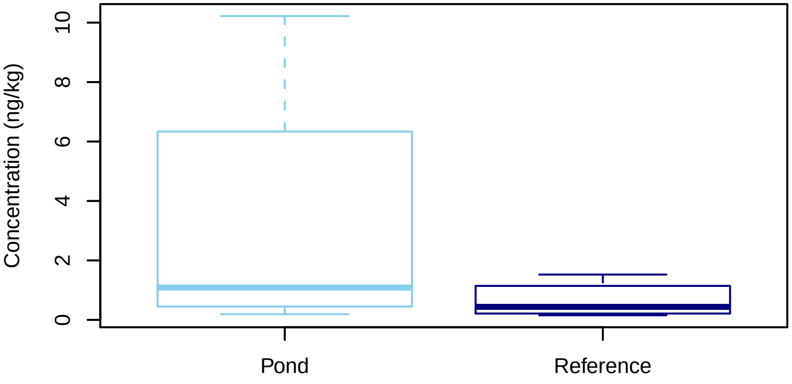


Summary Statistics

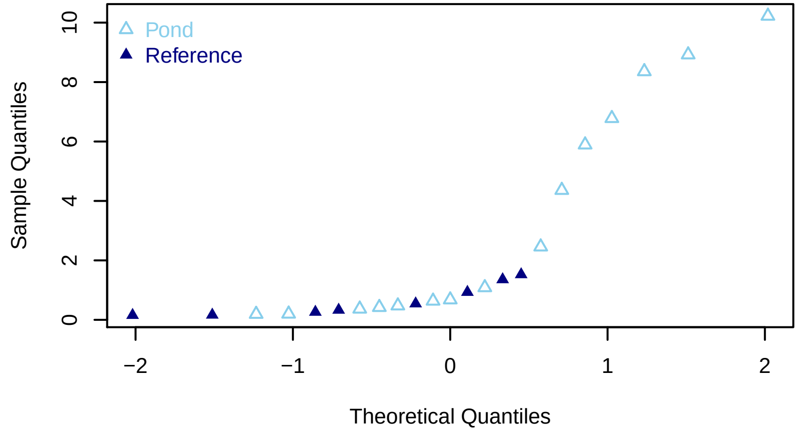
	Pond	Reference
Minimum	0.3402	0.08892
25th Percentile	0.6255	0.3735
Median	1.533	0.5716
Mean	4.504	1.261
75th Percentile	8.518	1.875
Maximum	12.62	3.965

Length Normalized
PCB−167

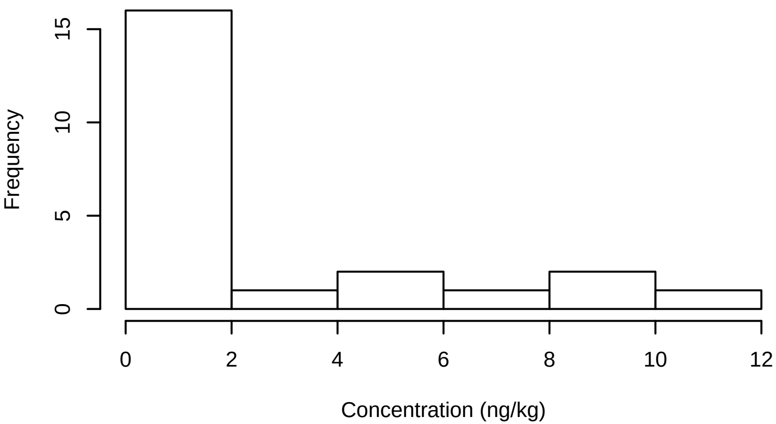
Box Plot



Normal Q−Q Plot



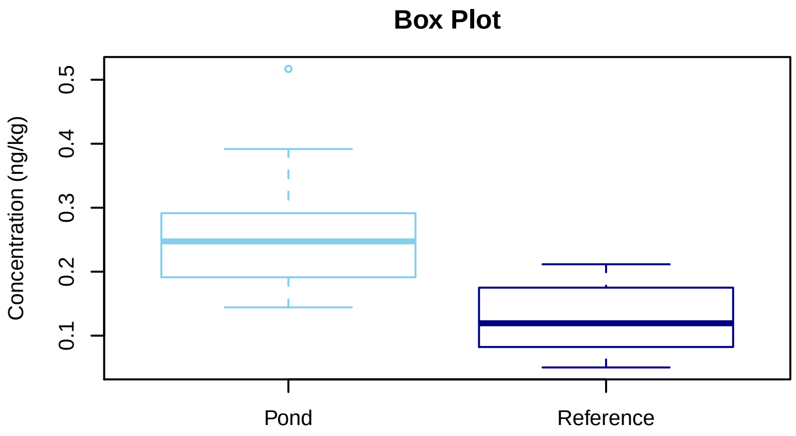
Histogram

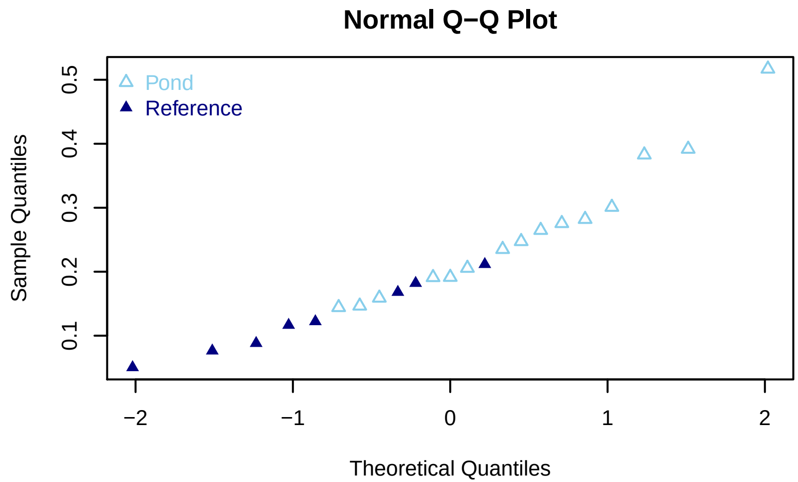


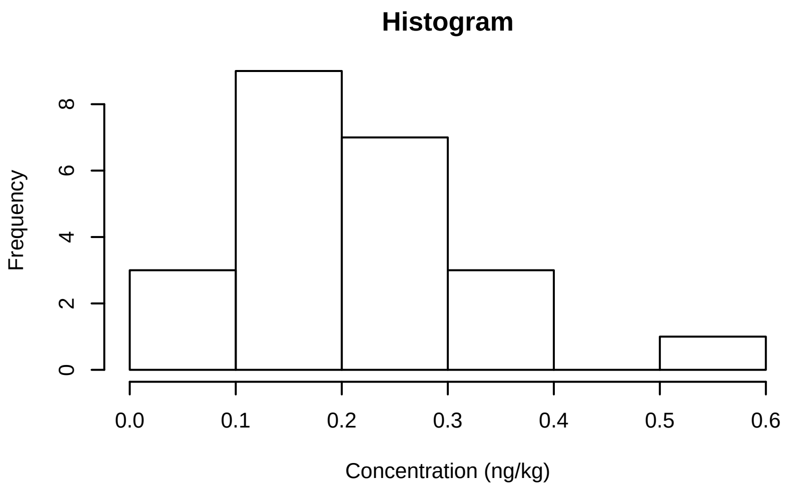
Summary Statistics

	Pond	Reference
Minimum	0.1914	0.1552
25th Percentile	0.4481	0.2375
Median	1.087	0.4373
Mean	3.402	0.6586
75th Percentile	6.335	1.037
Maximum	10.22	1.525

Length Normalized
PCB−169



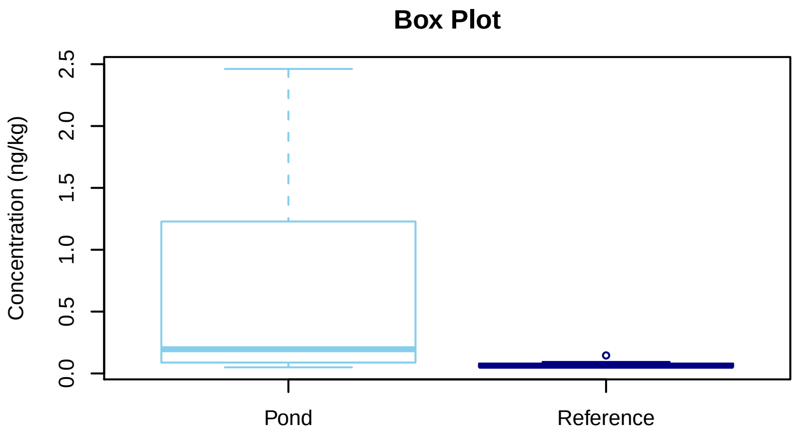


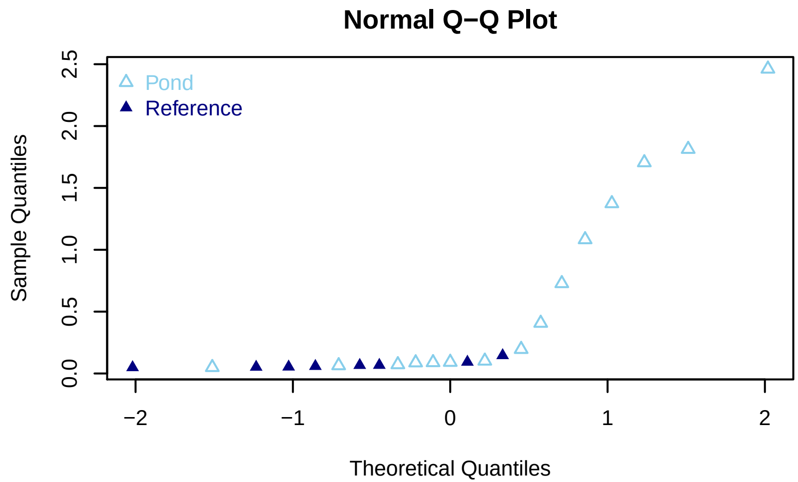


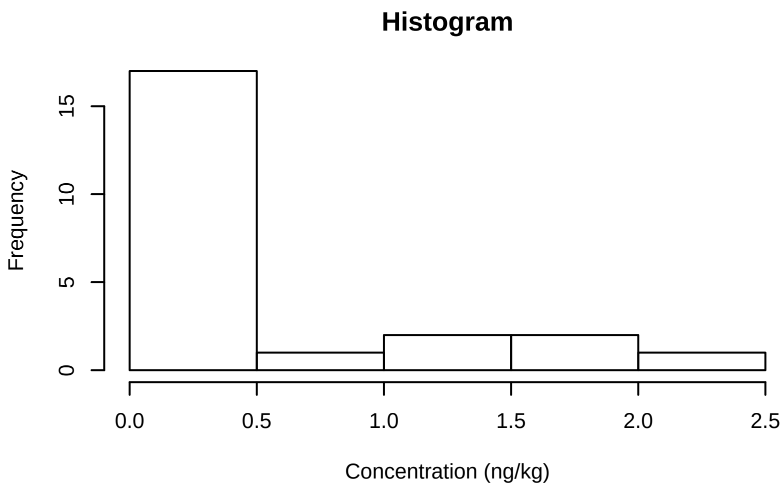
Summary Statistics

	Pond	Reference
Minimum	0.1442	0.05031
25th Percentile	0.1913	0.08521
Median	0.2474	0.1193
Mean	0.2623	0.1269
75th Percentile	0.2914	0.1715
Maximum	0.5169	0.2116

Length Normalized
PCB−189





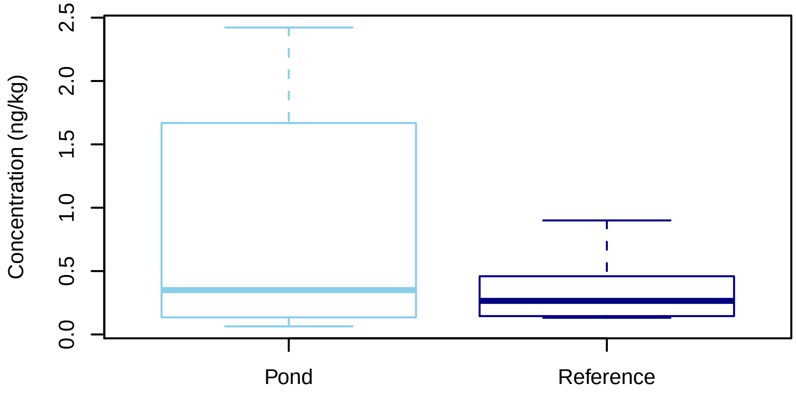


Summary Statistics

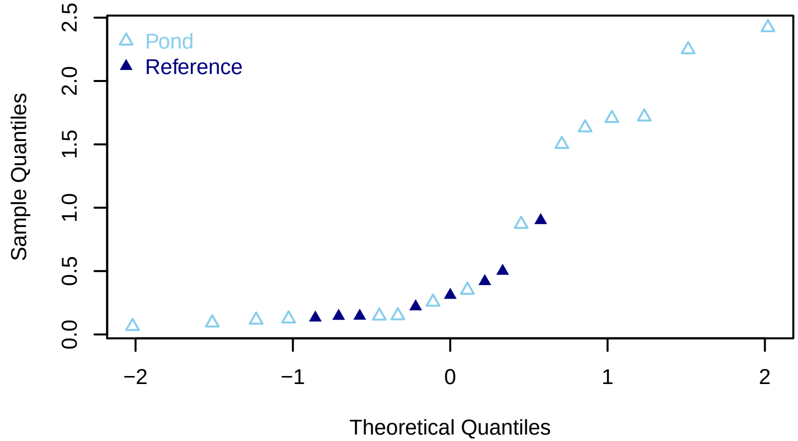
	Pond	Reference
Minimum	0.04936	0.04847
25th Percentile	0.08804	0.05309
Median	0.1956	0.06247
Mean	0.688	0.07303
75th Percentile	1.228	0.07358
Maximum	2.462	0.1456

Length Normalized
PCB−77

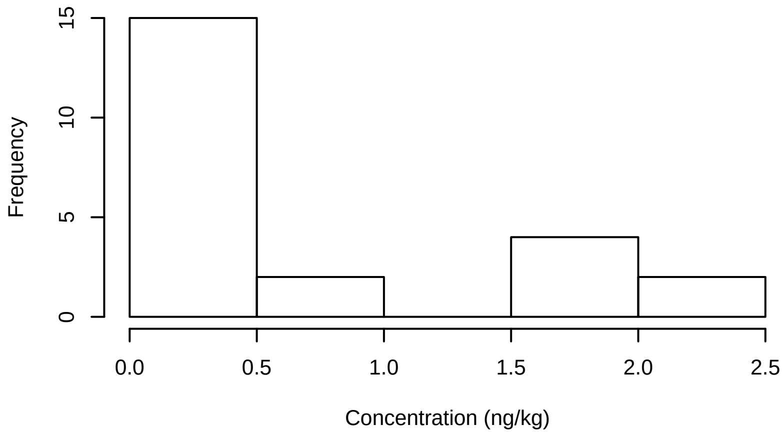
Box Plot



Normal Q−Q Plot



Histogram

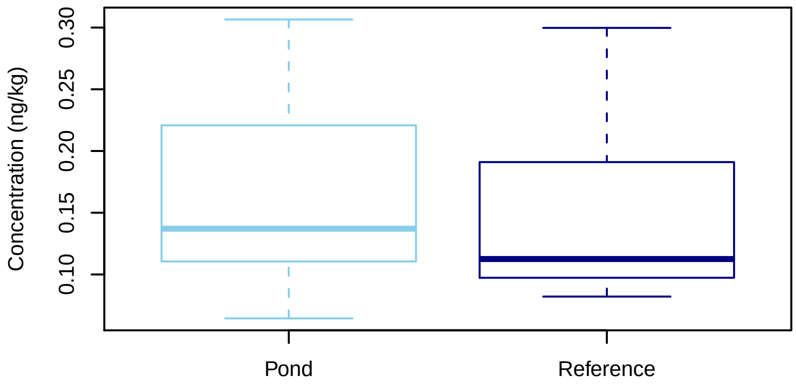


Summary Statistics

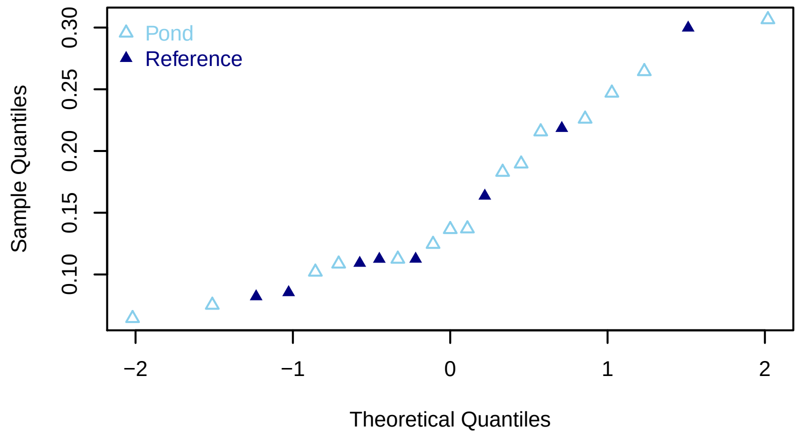
	Pond	Reference
Minimum	0.0639	0.1313
25th Percentile	0.1347	0.1452
Median	0.35	0.265
Mean	0.8927	0.3462
75th Percentile	1.668	0.439
Maximum	2.422	0.9

Length Normalized
PCB−81

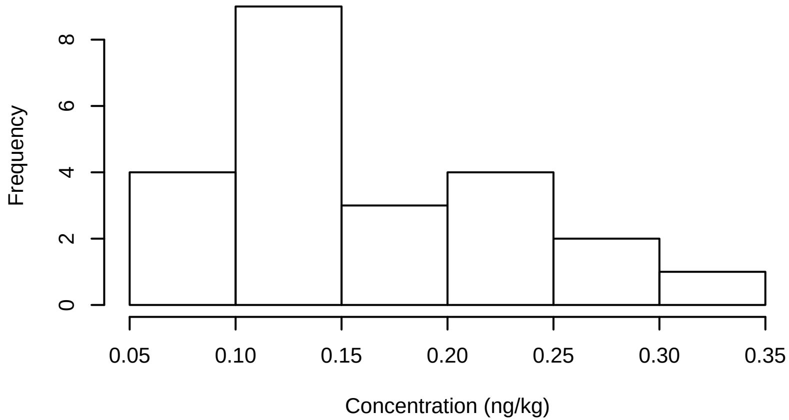
Box Plot



Normal Q−Q Plot



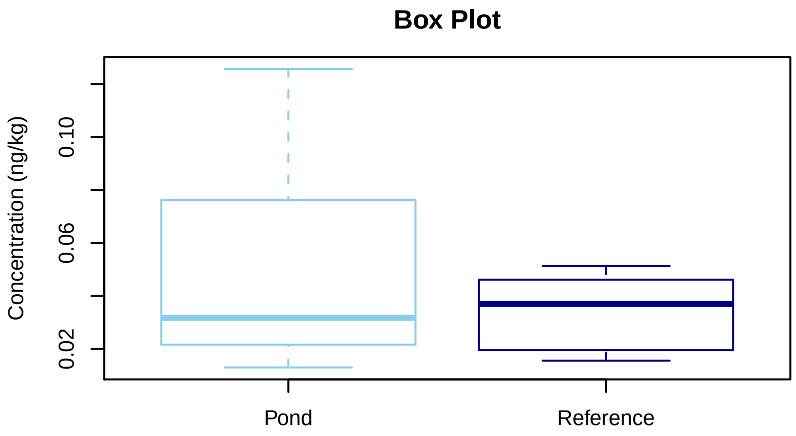
Histogram

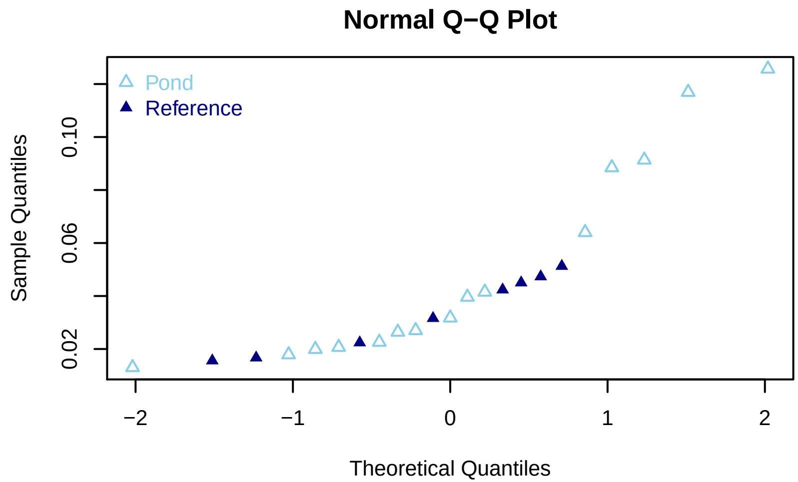


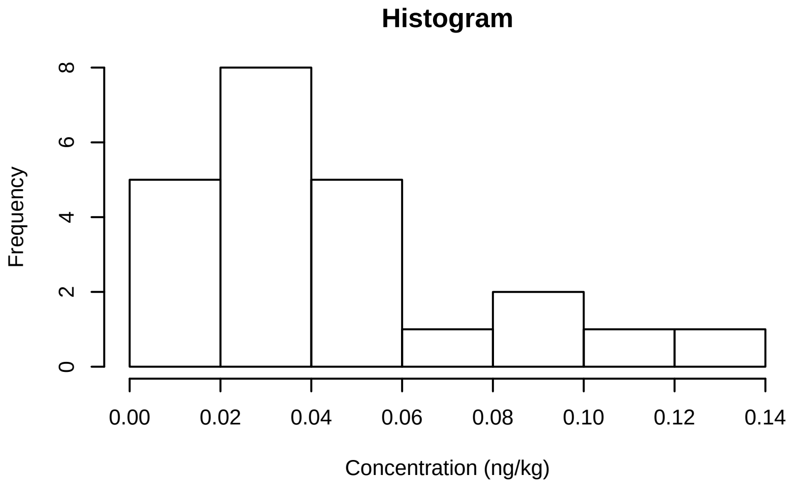
Summary Statistics

	Pond	**Reference**
Minimum	0.06446	0.0821
25th Percentile	0.1105	0.1033
Median	0.1371	0.1125
Mean	0.1662	0.1479
75th Percentile	0.2208	0.1773
Maximum	0.3065	0.2997

Length Normalized
TEQ PCB − Full DL



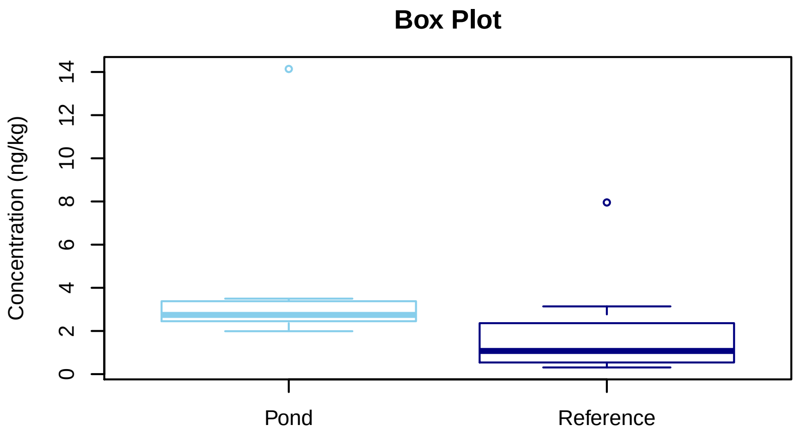


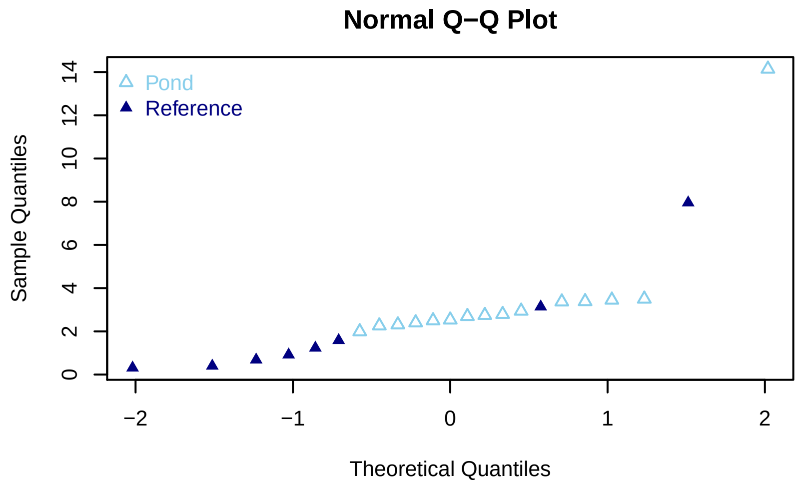


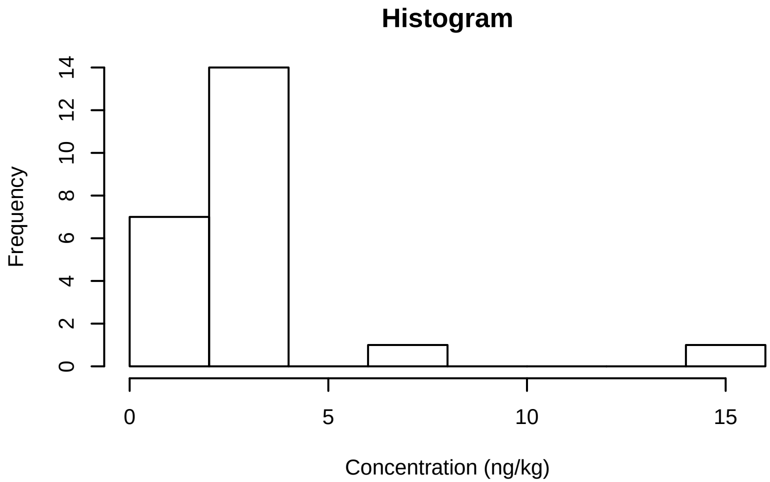
Summary Statistics

	Pond	Reference
Minimum	0.01303	0.01559
25th Percentile	0.02162	0.02097
Median	0.03174	0.03698
Mean	0.04978	0.03403
75th Percentile	0.07624	0.0456
Maximum	0.1257	0.05126

Lipid and Length Normalized
PCB−105





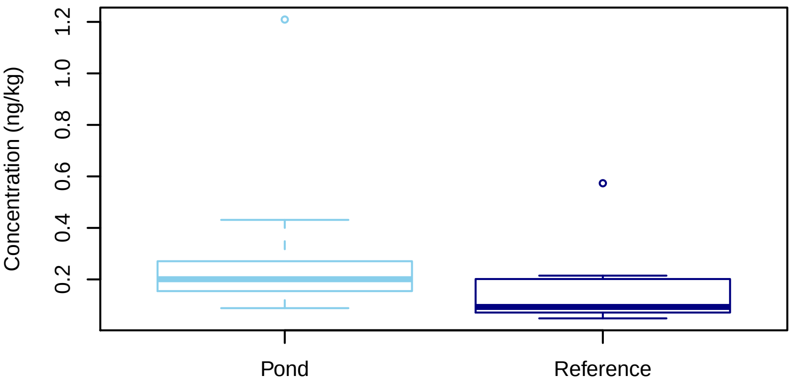


Summary Statistics

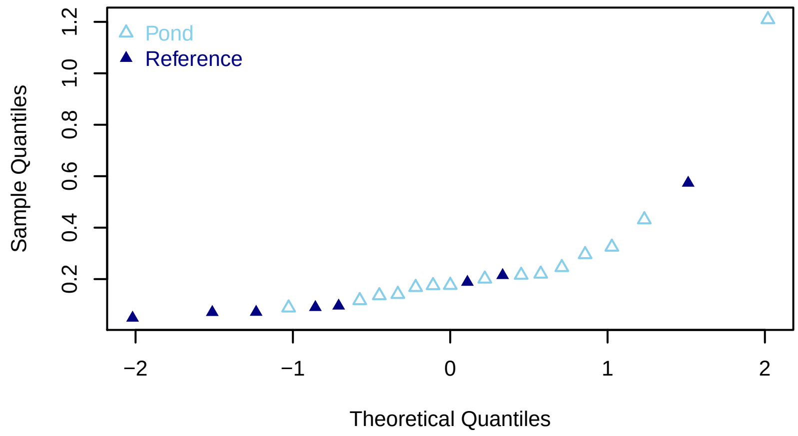
	Pond	Reference
Minimum	1.989	0.3108
25th Percentile	2.452	0.6116
Median	2.744	1.074
Mean	3.534	2.027
75th Percentile	3.378	1.972
Maximum	14.14	7.955

Lipid and Length Normalized
PCB−114

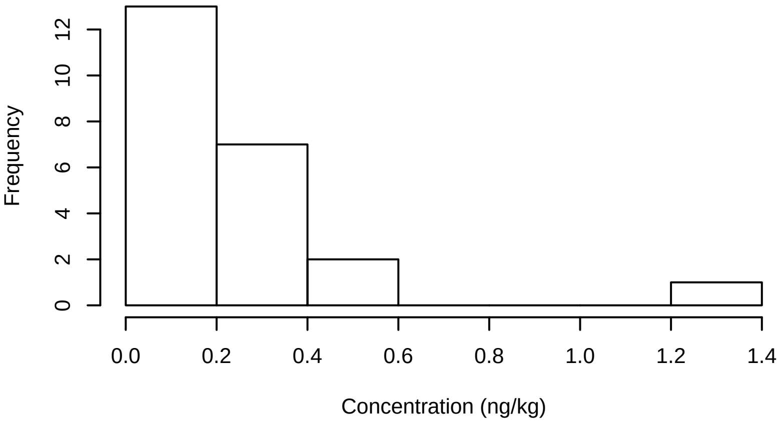
Box Plot



Normal Q−Q Plot



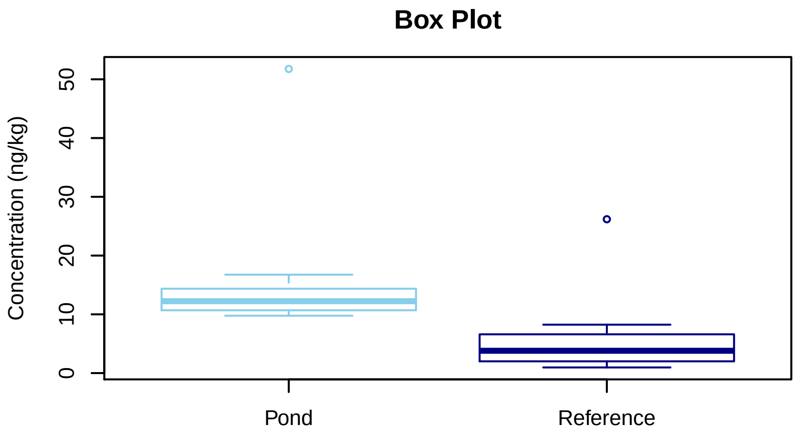
Histogram

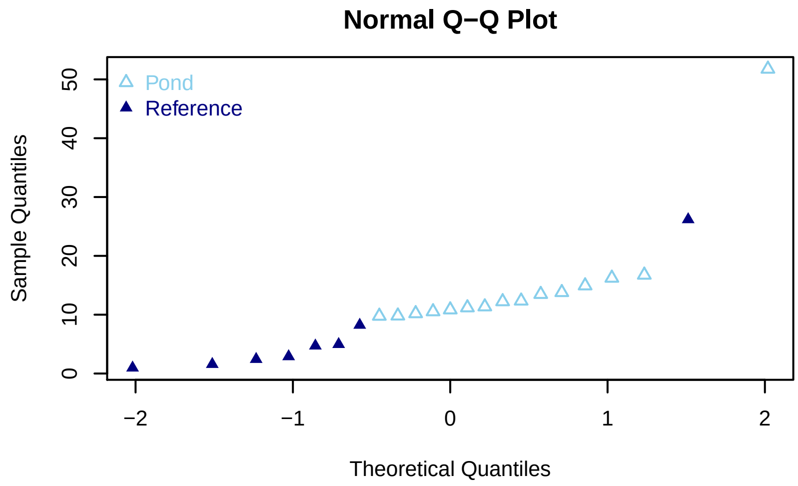


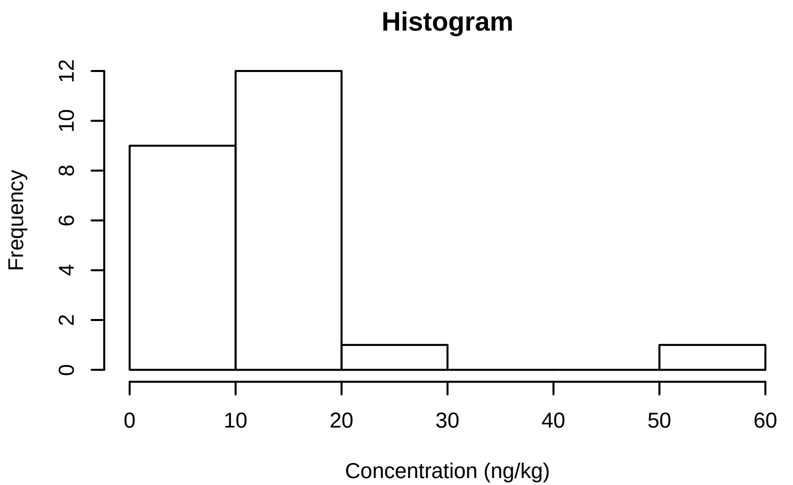
Summary Statistics

	Pond	Reference
Minimum	0.08839	0.04881
25th Percentile	0.1546	0.07156
Median	0.2008	0.09311
Mean	0.2763	0.1693
75th Percentile	0.2707	0.1949
Maximum	1.209	0.5736

Lipid and Length Normalized
PCB−118



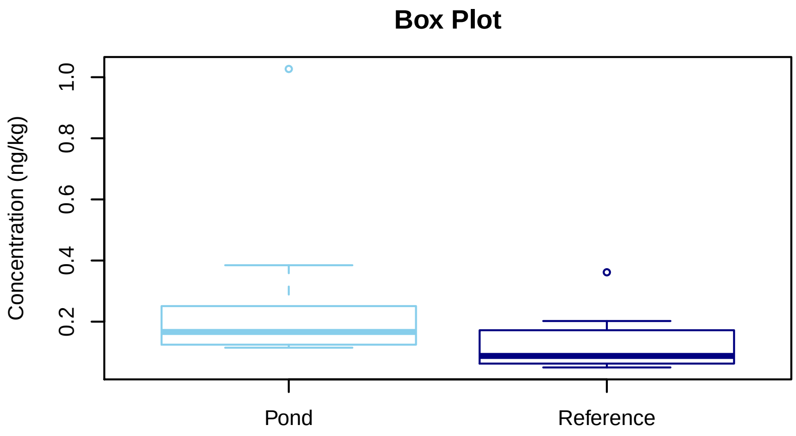


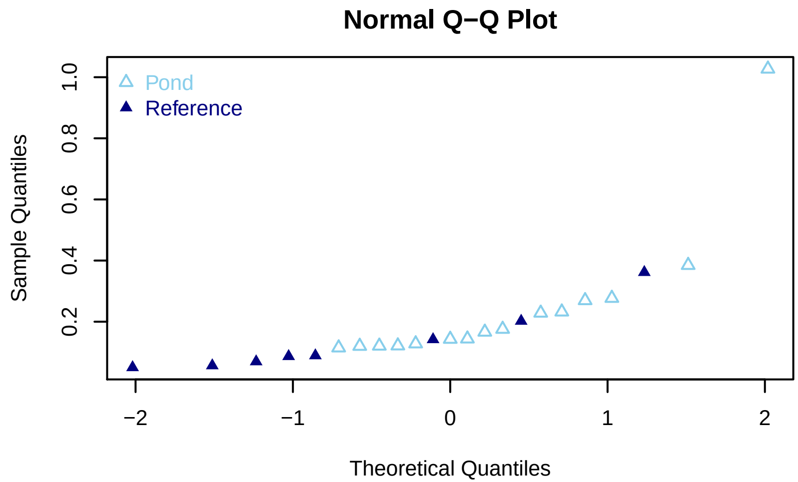


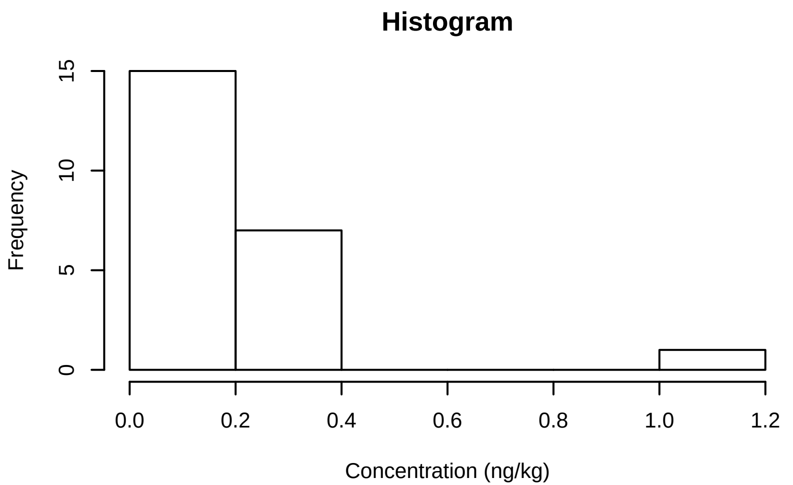
Summary Statistics

	Pond	Reference
Minimum	9.767	0.9652
25th Percentile	10.69	2.218
Median	12.24	3.802
Mean	15.02	6.497
75th Percentile	14.36	5.785
Maximum	51.76	26.18

Lipid and Length Normalized
PCB−123



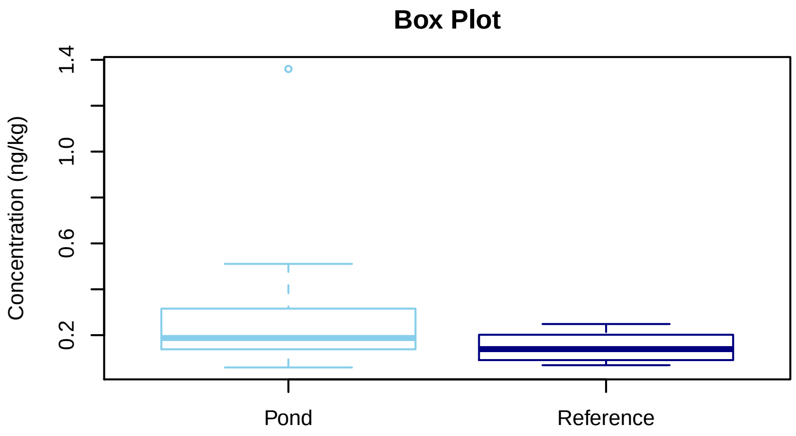


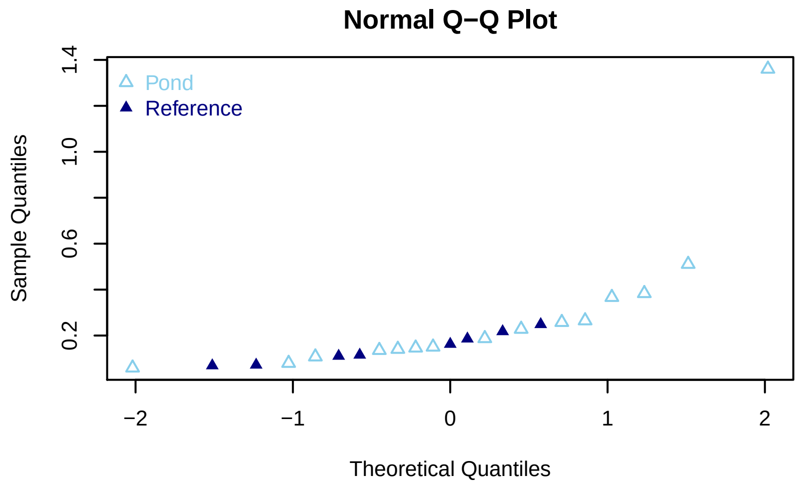


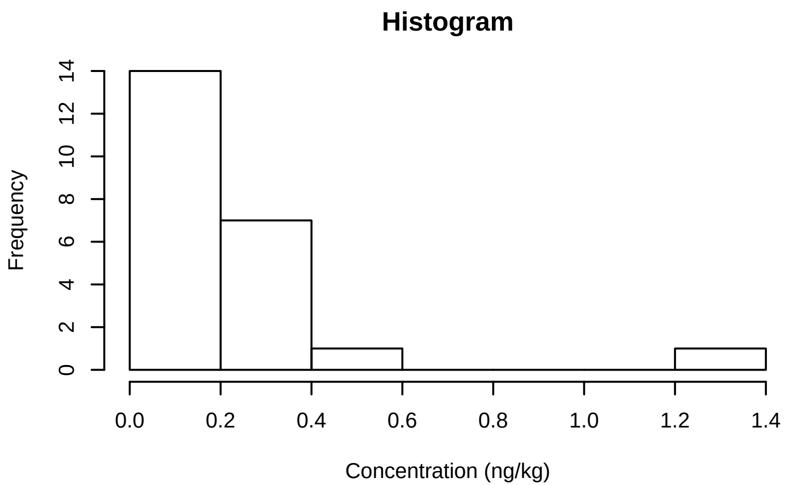
Summary Statistics

	Pond	**Reference**
Minimum	0.1147	0.05017
25th Percentile	0.1246	0.06606
Median	0.1662	0.0878
Mean	0.2434	0.1321
75th Percentile	0.2508	0.1569
Maximum	1.027	0.3616

Lipid and Length Normalized
PCB−126



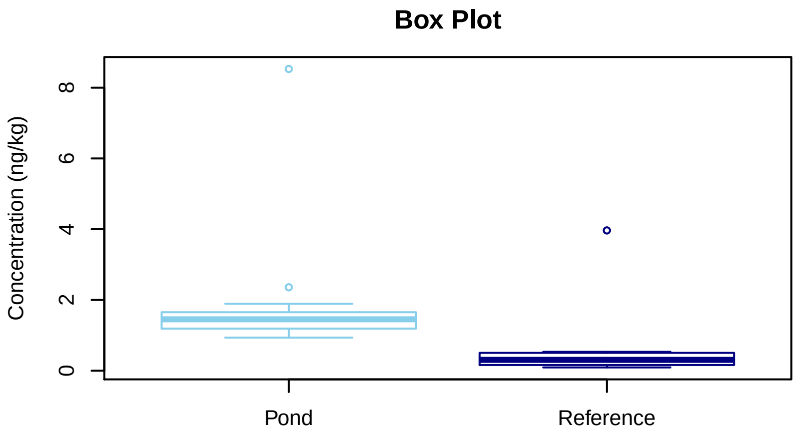


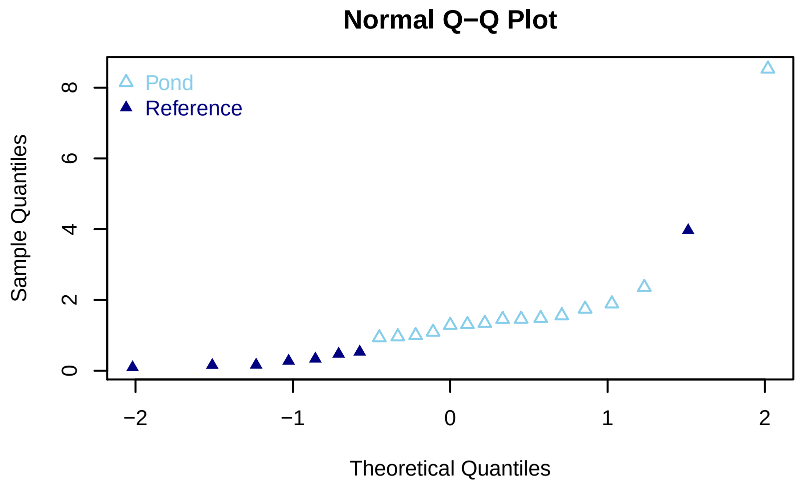


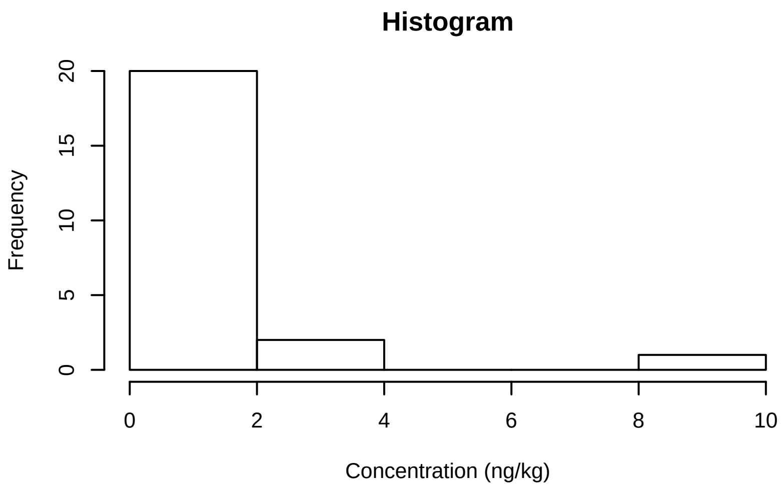
Summary Statistics

	Pond	**Reference**
Minimum	0.05941	0.06915
25th Percentile	0.1384	0.1011
Median	0.1875	0.1392
Mean	0.292	0.1478
75th Percentile	0.3158	0.1938
Maximum	1.36	0.2486

Lipid and Length Normalized
PCB−156/157





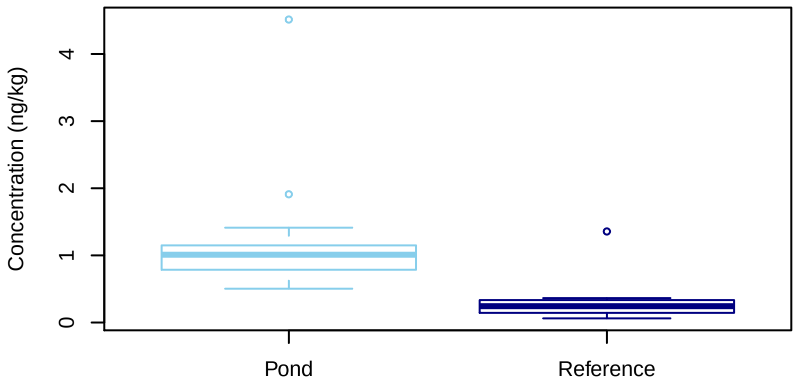


Summary Statistics

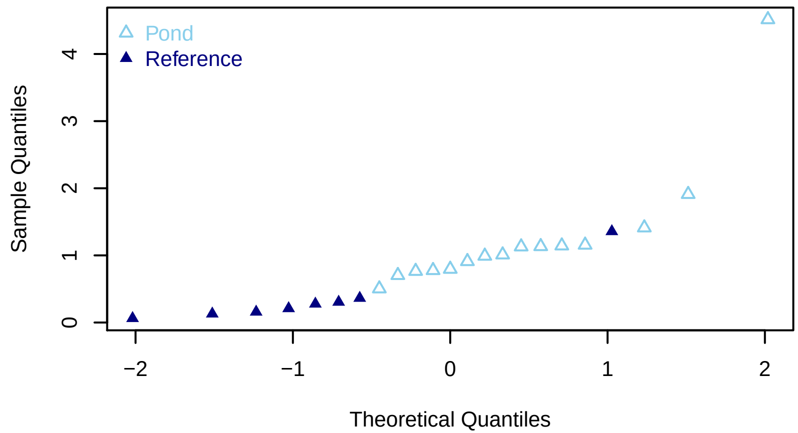
	Pond	Reference
Minimum	0.9364	0.09243
25th Percentile	1.191	0.1627
Median	1.453	0.3065
Mean	1.894	0.75
75th Percentile	1.652	0.4896
Maximum	8.53	3.965

Lipid and Length Normalized
PCB−167

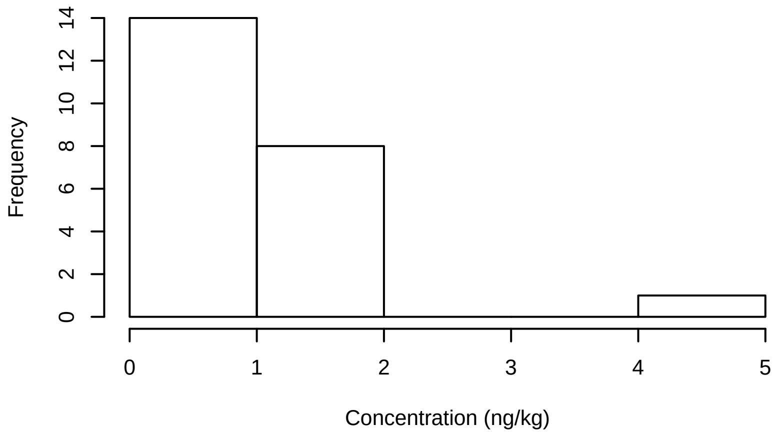
Box Plot



Normal Q−Q Plot



Histogram

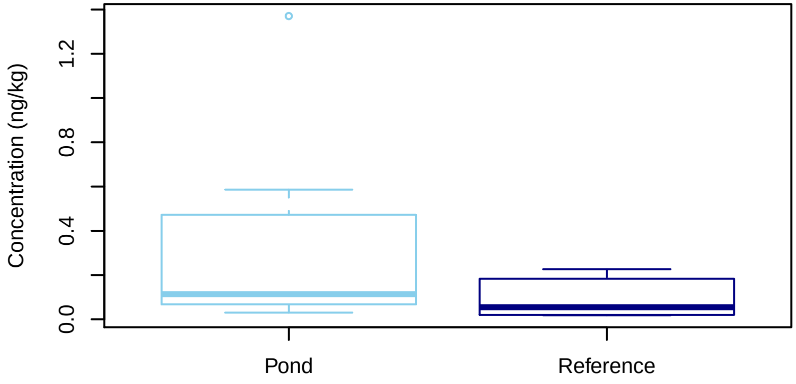


Summary Statistics

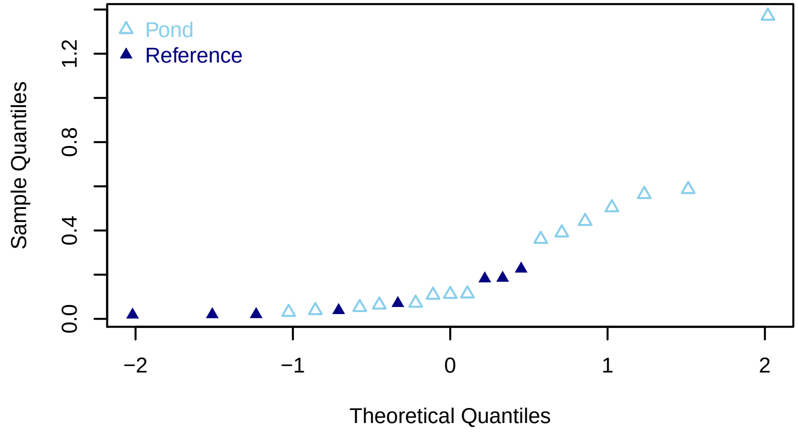
	Pond	**Reference**
Minimum	0.5037	0.06209
25th Percentile	0.7861	0.1507
Median	1.01	0.2433
Mean	1.257	0.3577
75th Percentile	1.149	0.3198
Maximum	4.513	1.357

Lipid and Length Normalized
PCB−169

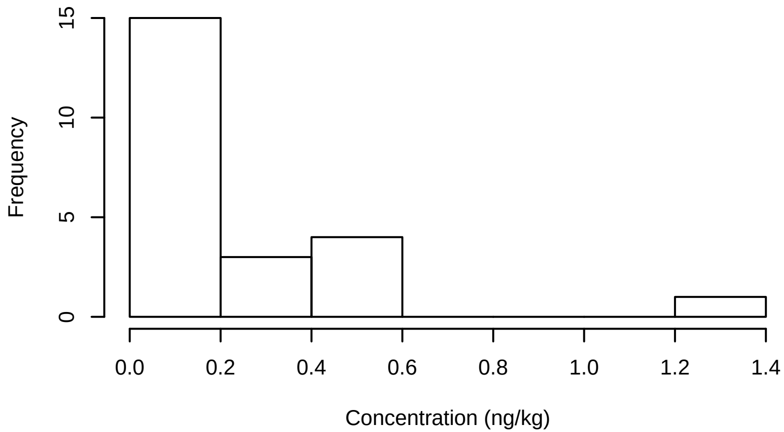
Box Plot



Normal Q−Q Plot



Histogram

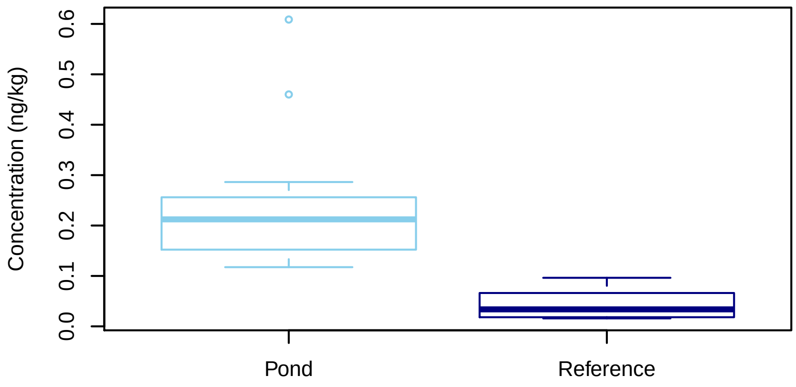


Summary Statistics

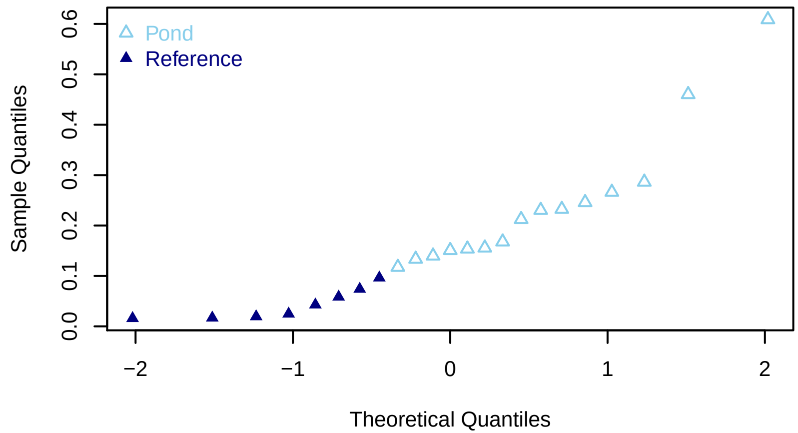
	Pond	Reference
Minimum	0.03013	0.01819
25th Percentile	0.06735	0.02003
Median	0.1135	0.05449
Mean	0.3202	0.09499
75th Percentile	0.4727	0.1827
Maximum	1.371	0.2262

Lipid and Length Normalized
PCB−189

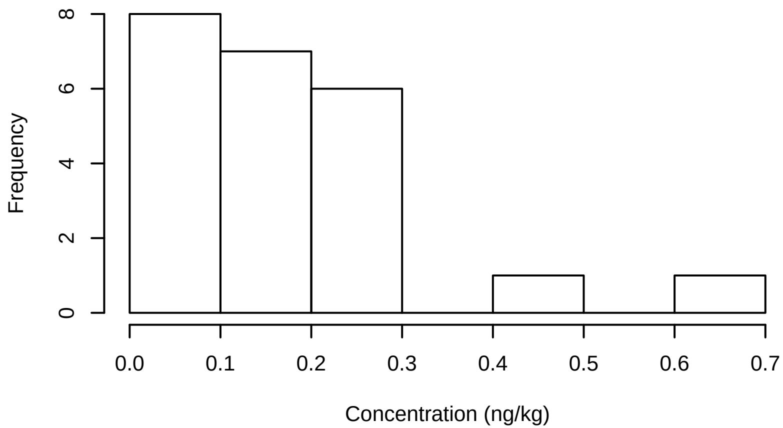
Box Plot



Normal Q−Q Plot



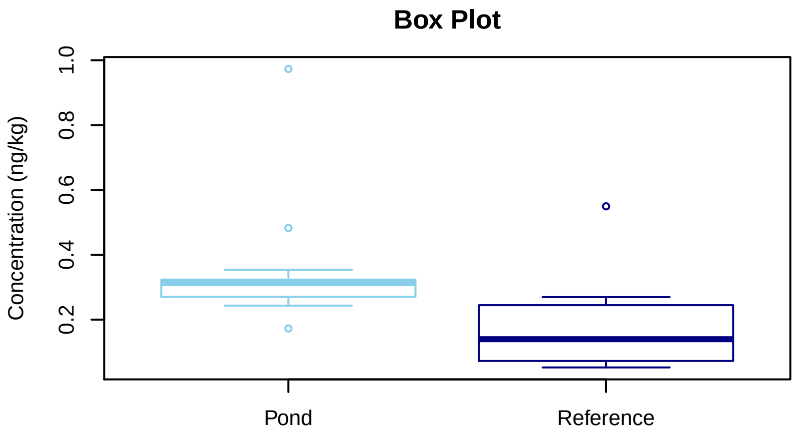
Histogram

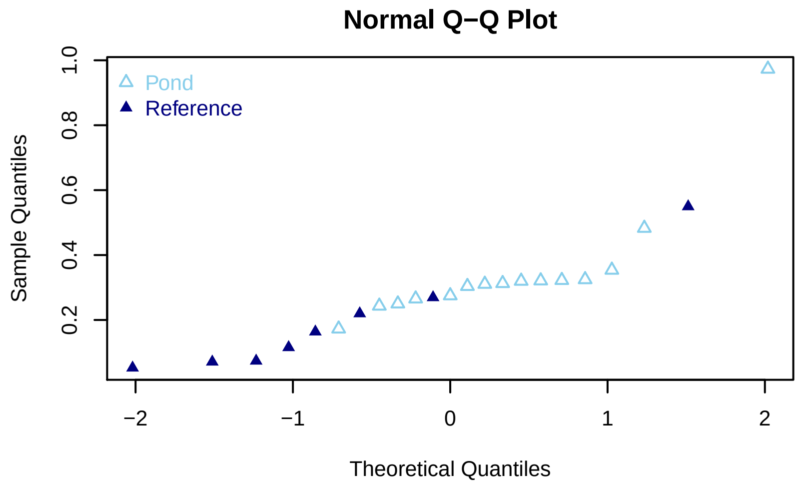


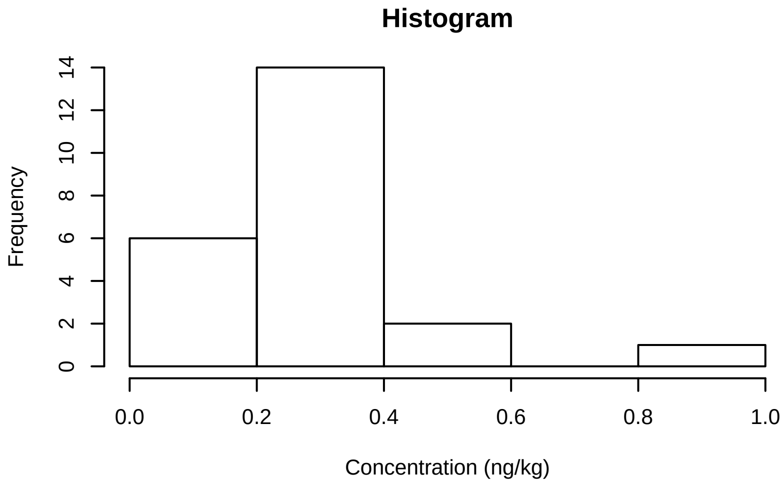
Summary Statistics

	Pond	Reference
Minimum	0.1174	0.01585
25th Percentile	0.1522	0.01874
Median	0.2123	0.03372
Mean	0.2374	0.04351
75th Percentile	0.2561	0.06225
Maximum	0.6087	0.09628

Lipid and Length Normalized
PCB−77



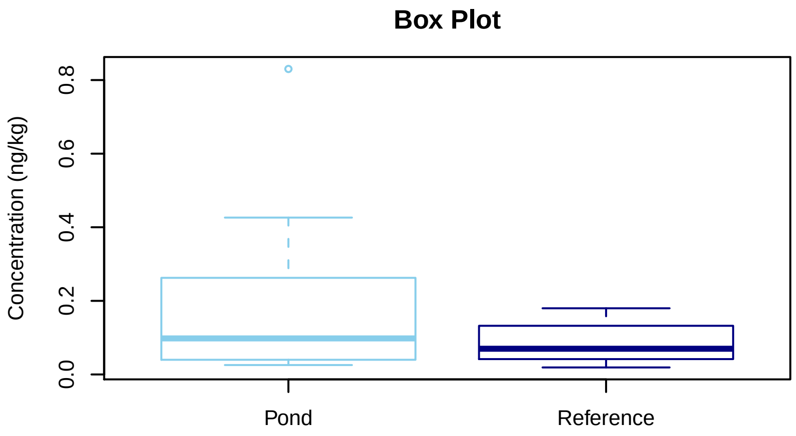


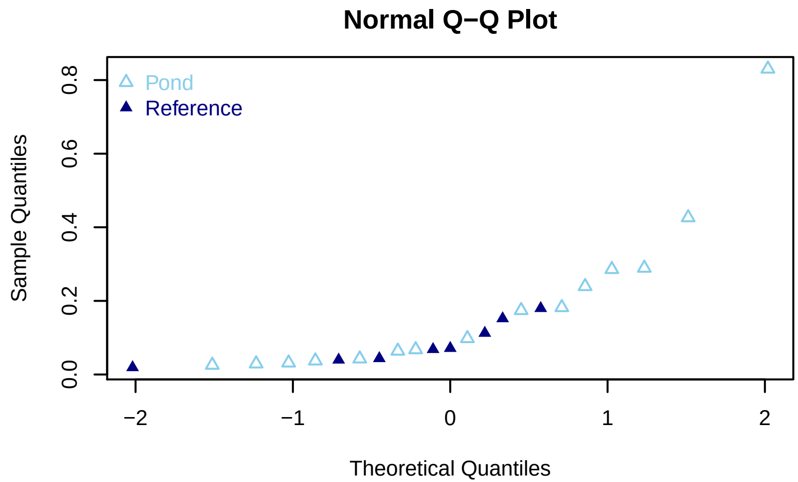


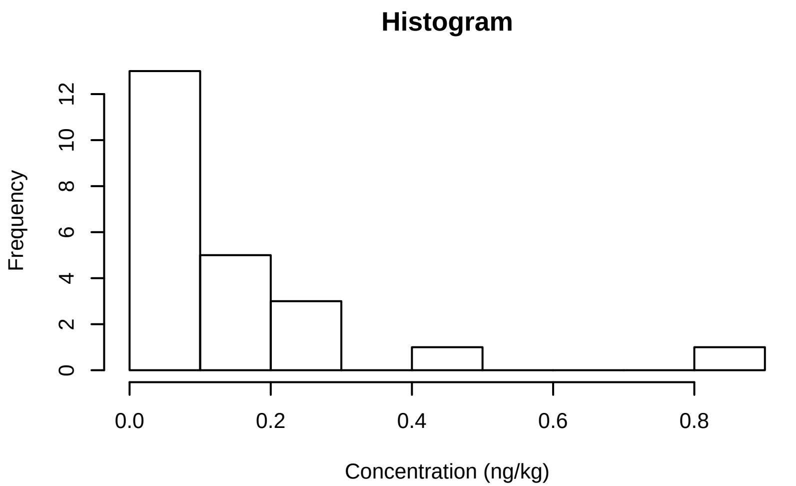
Summary Statistics

	Pond	Reference
Minimum	0.1727	0.05252
25th Percentile	0.2702	0.07316
Median	0.3128	0.1395
Mean	0.3487	0.1894
75th Percentile	0.3235	0.2321
Maximum	0.9731	0.5495

Lipid and Length Normalized
PCB−81





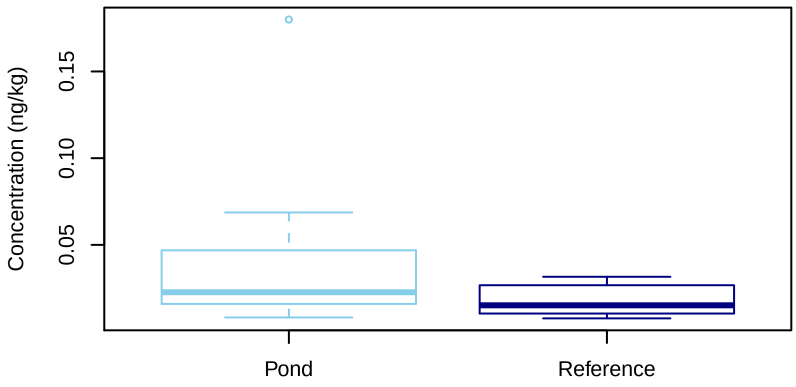


Summary Statistics

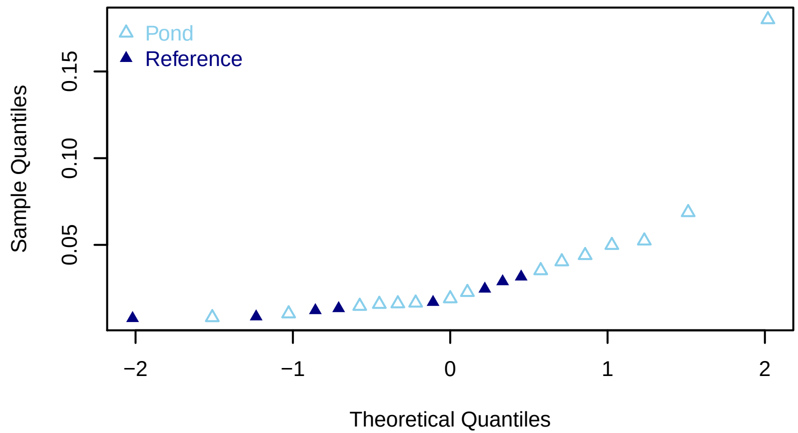
	Pond	Reference
Minimum	0.02552	0.01907
25th Percentile	0.03992	0.04269
Median	0.09792	0.06986
Mean	0.1882	0.08581
75th Percentile	0.2625	0.1224
Maximum	0.8302	0.1798

Lipid and Length Normalized
TEQ PCB − Full DL

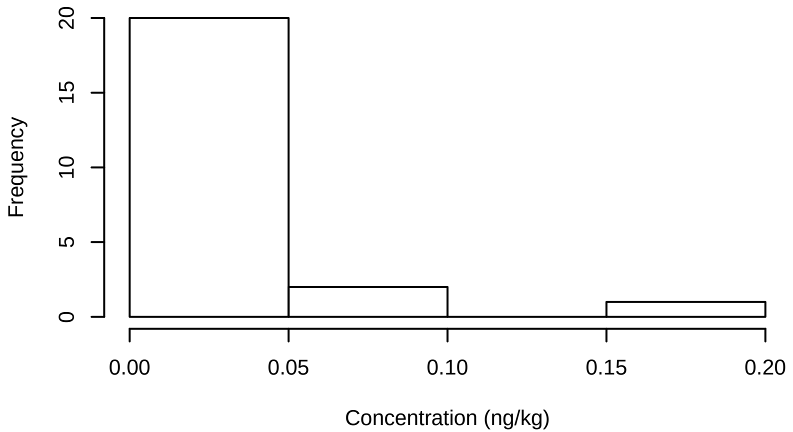
Box Plot



Normal Q−Q Plot



Histogram



Summary Statistics

	Pond	Reference
Minimum	0.00814	0.007631
25th Percentile	0.01596	0.01131
Median	0.02267	0.01515
Mean	0.03957	0.01798
75th Percentile	0.04687	0.02568
Maximum	0.1799	0.03159

Comparison of Site Data to Background Data

This section describes the statistical methodologies used to compare TEQ pond data with reference data to determine if the analytical results obtained from the samples represent site conditions or background/anthropogenic conditions. For the background comparison site pond lipid normalized values, length normalized values, and lipid and length normalized values were compared to reference lipid normalized values, length normalized values, and lipid and length normalized values.

The comparison of the pond data with the reference data was performed by examining summary statistics, box plots, and probability plots, comparing twice the reference average to the site maximum, and formal statistical hypothesis test.

Probability plots are a useful first set for visually comparing two data sets in a single graph. The probability plot is useful because it provides a direct visual comparison of the two data sets. If the site and background distributions were exactly identical, the plotted values would lie on a straight line through the origin. Deviations from this line show the differences between the two distributions. If the site and background distributions are similar the scattering of the two data sets will be mixed. If there is grouping of the two data sets then data sets are most likely different.

Box plots show the central tendency, degree of symmetry, range of variation, and potential outliers of a data set. The data set is shown as a rectangular box that represents the middle 50 percent of the data. The upper value of the box (75% percentile) and the lower value of the box (25^{th} percentile) define the top and bottom of the rectangle respectively. The median is represented by the middle line in the box. Box and whisker plots for the same analyte in the two data sets were plotted on the same graph. The plots were visually inspected to see which data sets look similar and which ones differed. Particular attention was paid to see if the median from one data set fell within the 75^{th} and 25^{th} percentile range of the other data sets.

Lipid Normalized

Based on the box plots, the pond data appear to be slightly shifted above the reference data. This shift can be seen by the pond median being roughly equal to the reference upper whisker. Also there is one potential reference outlier that is roughly equal to the 75th percentile of the pond data. The normal probability plot shows a mixing of the data sets in the lower tail, however the four largest concentrations are all from the pond data set and appear to have a different slope then the rest of the data. The histogram of the combined data sets is right skewed with two concentrations separated from the rest of the data set. The minimum, 25th percentile, median, mean, 75th percentile, and maximum pond concentrations are all greater than the corresponding reference concentration.

The reference mean concentration is 0.81mg/kg and two times the reference mean is 1.62mg/kg. The pond maximum concentration is 5.8mg/kg which is greater than 1.62mg/kg. Based on comparing the pond maximum concentration to two times the reference concentration the pond lipid normalized values are greater than the reference lipid normalized values.

Using the Shapiro Wilk normality test it was determined that the pond lipid normalized values are not normally distributed while the reference lipid normalized values are normally distributed. Since one of the two data sets is not normally distributed the Wilcoxon Rank Sum (WRS) hypothesis test was used to compare the pond mean lipid normalized concentration to the reference mean lipid normalized concentration plus one reference lipid normalized standard deviation. The null hypothesis was that the pond lipid normalized concentrations are greater than or equal to the reference mean lipid normalized concentration plus one reference lipid normalized standard deviation. The p-value for the hypothesis test was 0.55, therefore it was concluded that the pond lipid normalized concentrations are greater than or equal to the reference mean lipid normalized concentration plus one reference lipid normalized standard deviation.

Length Normalized

Based on the box plots, the pond data appear to have more variability in the higher concentrations than the reference data. The higher variability of the pond data can be seen by the pond data box plot not being symmetrical while the reference box plot is roughly symmetrical. Notice that the two median concentrations are roughly equal while the 75th percentile of the pond data is greater than the upper whisker of the reference data. The normal probability plot shows a mixing of the data sets in the lower tail, however the five largest concentrations are all from the pond data set and appear to have a different slope then the rest of the data. The histogram of the combined data sets is right skewed.

The reference mean concentration is 0.03mg/kg and two times the reference mean is 0.06mg/kg. The pond maximum concentration is 0.13mg/kg which is greater than 0.06mg/kg. Based on comparing the pond maximum concentration to two times the reference concentration the pond length normalized values are greater than the reference length normalized values.

Using the Shapiro Wilk normality test it was determined that the pond length normalized values are not normally distributed while the reference length normalized values are normally distributed. Since one of the two data sets is not normally distributed the Wilcoxon Rank Sum (WRS) hypothesis test was used to compare the pond mean length normalized concentration to the reference mean length normalized concentration plus one reference length normalized standard deviation. The null hypothesis was that the pond length normalized concentrations are greater than or equal to the reference mean length normalized concentration plus one reference length normalized standard deviation. The p-value for the hypothesis test was 0.086, therefore it was concluded that the pond length normalized concentrations are greater than or equal to the reference mean length normalized concentration plus one reference length normalized standard deviation.

Lipid and Length Normalized

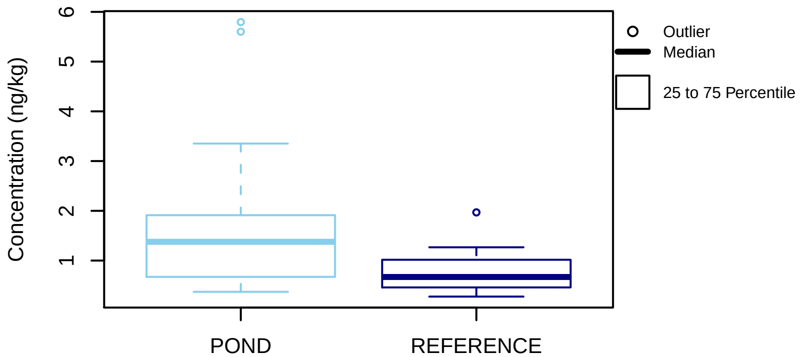
Based on the box plots, the pond data appear to have more variability in the higher concentrations than the reference data. The higher variability of the pond data can be seen by the pond data box plot not being symmetrical while the reference box plot is roughly symmetrical. The higher variability can also be seen by the roughly equal median concentrations while the 75th percentile of the pond data is greater than the upper whisker of the reference data. The normal probability plot shows a mixing of the data sets in the lower tail, however the eight largest concentrations are all from the pond data set and appear to have a different slope then the rest of the data. The histogram of the combined data sets is right skewed with one concentration separated from the rest of the data.

The reference mean concentration is 0.02mg/kg and two times the reference mean is 0.04mg/kg. The pond maximum concentration is 0.18mg/kg which is greater than 0.04mg/kg. Based on comparing the pond maximum concentration to two times the reference concentration the pond lipid and length normalized values are greater than the reference lipid and length normalized values.

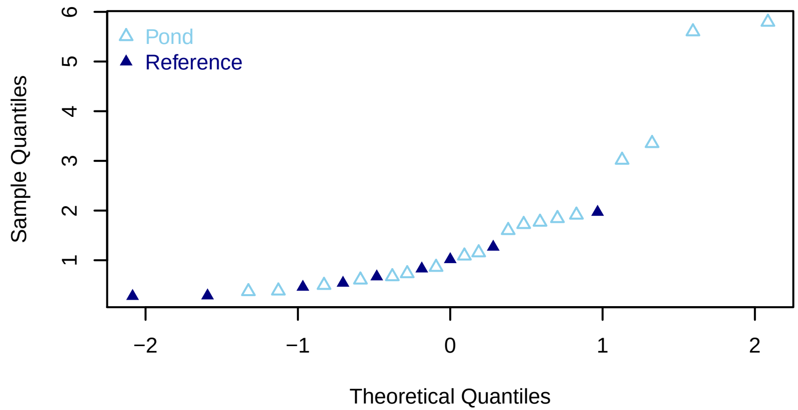
Using the Shapiro Wilk normality test it was determined that the pond lipid and length normalized values are not normally distributed while the reference lipid and length normalized values are normally distributed. Since one of the two data sets is not normally distributed the Wilcoxon Rank Sum (WRS) hypothesis test was used to compare the pond mean lipid and length normalized concentration to the reference mean lipid and length normalized concentration plus one reference lipid and length normalized standard deviation. The null hypothesis was that the pond lipid and length normalized concentrations are greater than or equal to the reference mean lipid and length normalized concentration plus one reference lipid and length normalized standard deviation. The p-value for the hypothesis test was 0.429, therefore it was concluded that the pond lipid and length normalized concentrations are greater than or equal to the reference mean lipid and length normalized concentration plus one reference lipid and length normalized standard deviation.

EXHIBIT 5−1
PCB TEQ
LIPID NORMALIZED
SITE/SWMU 3 − CAUSEWAY LANDFILL

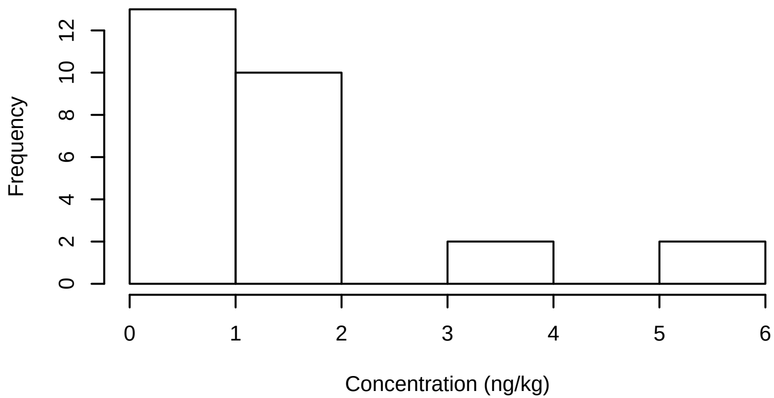
Box Plot



Normal Q−Q Plot



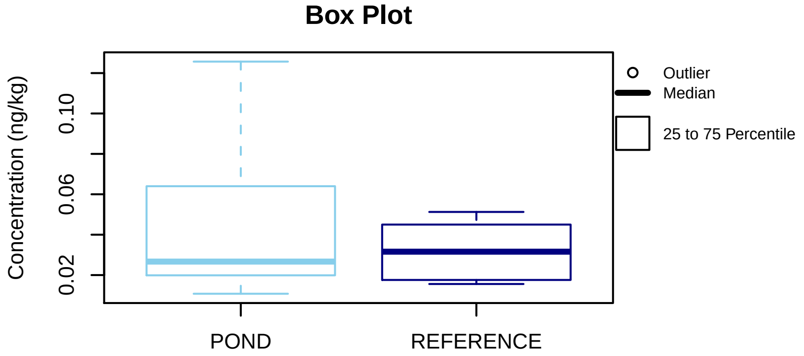
Histogram

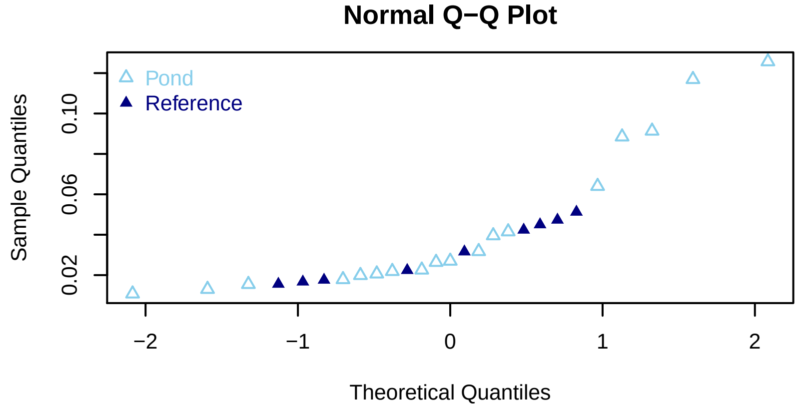


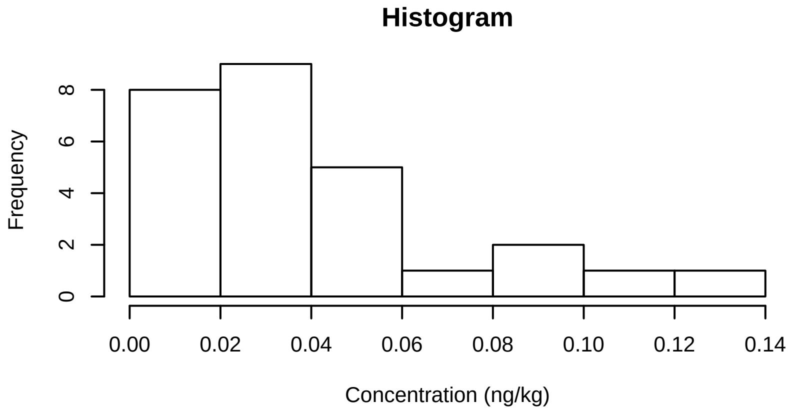
Summary Statistics

	Pond (ng/kg)	Reference (ng/kg)
Minimum	0.37	0.28
25th Percentile	0.69	0.46
Median	1.38	0.67
Mean	1.83	0.81
75th Percentile	1.89	1.02
Maximum	5.79	1.97

EXHIBIT 5−2
PCB TEQ
LENGTH NORMALIZED
SITE/SWMU 3 − CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA





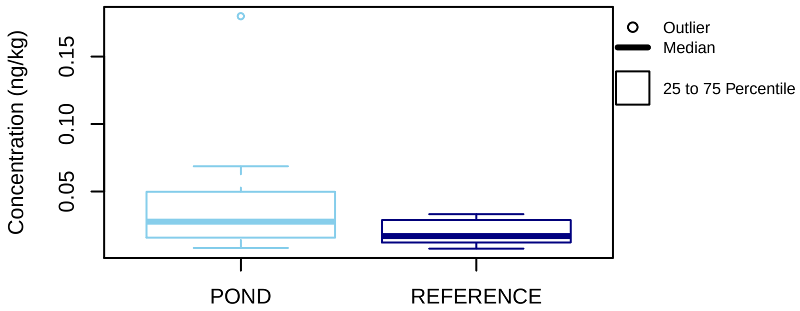


Summary Statistics

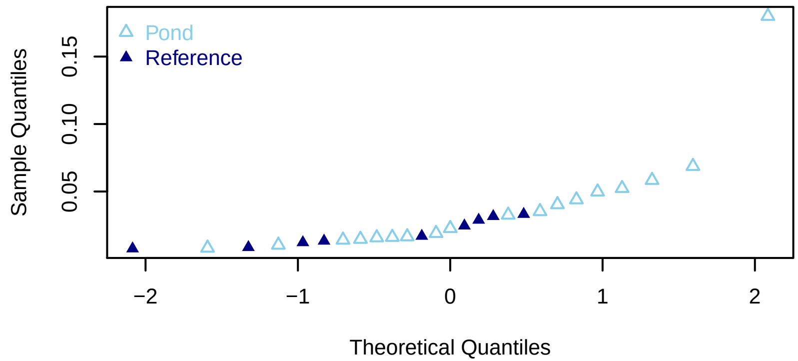
	Pond (ng/kg)	Reference (ng/kg)
Minimum	0.01	0.02
25th Percentile	0.02	0.02
Median	0.03	0.03
Mean	0.04	0.03
75th Percentile	0.06	0.05
Maximum	0.13	0.05

EXHIBIT 5−3
PCB TEQ
LIPID AND LENGTH NORMALIZED
SITE/SWMU 3 − CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

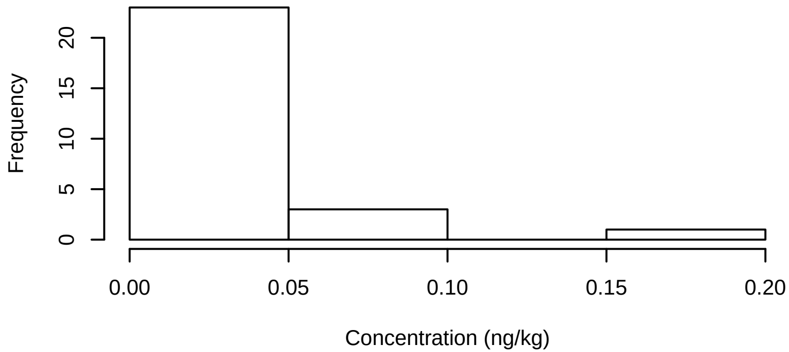
Box Plot



Normal Q−Q Plot



Histogram



Summary Statistics

	Pond (ng/kg)	Reference (ng/kg)
Minimum	0.01	0.01
25th Percentile	0.02	0.01
Median	0.03	0.02
Mean	0.04	0.02
75th Percentile	0.05	0.03
Maximum	0.18	0.03

Comparison of Site Data to Background Data by Fish Species

For the background comparison site pond lipid normalized values, length normalized values, and lipid and length normalized values were compared to reference lipid normalized values, length normalized values, and lipid and length normalized values. For all three data sets some of the PCB congeners were determined to not represent background conditions. To determine if the differences detected between the PCB congener concentrations for the pond and reference data sets were due to the three fish species the concentrations of the PCB congeners for each data set were compared for each fish species. Due to the limited sample size, maximum of three samples per species, only the comparison of the maximum pond concentration to twice the reference concentration was conducted.

For the statistical analyses the detection limit was used for non-detected concentrations. There were four red drum fish that exceeded the length and would not therefore have been returned. The four samples that were removed are PAI-03-RD-03-03, PAI-03-RD-03-04, PAI-03-RD-04-01, and PAI-03-RD-RF-06. The concentrations identified as Tukey outliers in the comparison of all the pond fish species to all the reference species were not used in this comparison.

Tables 1, 2, and 3 display the results of the comparison of the pond maximum concentration to twice the reference average concentration by species for the lipid normalized, length normalized, and lipid and length normalized PCB congener data. If the maximum pond concentration is greater than twice the reference average then the pond concentrations do not represent background conditions, if the maximum pond concentration is less than twice the reference average then the pond concentrations represent background conditions.

Table 1 Lipid Normalized Comparison						
Parameter	Species	Pond Sample Size	Reference Sample Size	Maximum Pond Concentration (ng/kg)	Average Reference Concentration (ng/kg)	Region 4 Comparison
PCB-118	Mullet	8	4	870	87	Pond does not represent Background
PCB-105	Mullet	8	4	180	24	Pond does not represent Background
PCB-156/157	Mullet	7	4	74	9	Pond does not represent Background
PCB-167	Mullet	7	4	55	5.7	Pond does not represent Background
PCB-169	Mullet	8	4	5.5	0.91	Pond does not represent Background
PCB-77	Mullet	8	4	17	3.3	Pond does not represent Background
PCB-81	Mullet	8	4	4.7	1.7	Pond does not represent Background
PCB-126	Mullet	8	4	9	4.3	Pond does not represent Background
PCB-189	Mullet	7	4	11	0.75	Pond does not represent Background
PCB-114	Mullet	8	4	11	2.8	Pond does not represent Background
PCB-123	Mullet	8	4	8.4	2.5	Pond does not represent Background
TEQ PCB -	Mullet	8	4	1.1	0.46	Pond does not represent Background
PCB-118	Red Drum	3	2	810	150	Pond does not represent Background
PCB-105	Red Drum	3	2	180	46	Pond does not represent Background
PCB-156/157	Red Drum	3	2	95	9.7	Pond does not represent Background
PCB-167	Red Drum	3	2	54	9.6	Pond does not represent Background
PCB-169	Red Drum	3	3	28	6	Pond does not represent Background
PCB-77	Red Drum	3	3	17	7.7	Pond does not represent Background
PCB-81	Red Drum	3	3	14	4.2	Pond does not represent Background
PCB-126	Red Drum	2	3	12	7.4	Pond represents Background
PCB-189	Red Drum	3	3	12	2.5	Pond does not represent Background
PCB-114	Red Drum	2	2	11	5.7	Pond represents Background
PCB-123	Red Drum	2	2	9.1	5.4	Pond represents Background
TEQ PCB -	Red Drum	3	3	3.4	0.94	Pond does not represent Background
PCB-118	Black Drum	3	1	440	220	Pond does not represent Background
PCB-105	Black Drum	3	1	110	85	Pond represents Background
PCB-156/157	Black Drum	3	1	58	15	Pond does not represent Background
PCB-167	Black Drum	3	1	45	9.9	Pond does not represent Background
PCB-169	Black Drum	3	1	23	5	Pond does not represent Background
PCB-77	Black Drum	3	1	18	15	Pond represents Background
PCB-81	Black Drum	3	1	16	4.9	Pond does not represent Background
PCB-126	Black Drum	3	1	14	5.1	Pond does not represent Background
PCB-189	Black Drum	3	1	6.2	2	Pond does not represent Background
PCB-114	Black Drum	3	1	11	5.1	Pond does not represent Background
PCB-123	Black Drum	3	1	10	3.9	Pond does not represent Background
TEQ PCB -	Black Drum	3	1	1.8	0.67	Pond does not represent Background

Table 2 Length Normalized Comparison						
Parameter	Species	Pond Sample Size	Reference Sample Size	Maximum Pond Concentration (ng/kg)	Average Reference Concentration (ng/kg)	Region 4 Comparison
PCB-118	Mullet	8	4	95	12	Pond does not represent Background
PCB-105	Mullet	8	4	19	3.3	Pond does not represent Background
PCB-156/157	Mullet	8	4	13	1.3	Pond does not represent Background
PCB-167	Mullet	8	4	10	0.79	Pond does not represent Background
PCB-189	Mullet	8	3	2.5	0.069	Pond does not represent Background
PCB-77	Mullet	8	4	2.4	0.44	Pond does not represent Background
PCB-114	Mullet	8	4	1.2	0.31	Pond does not represent Background
PCB-126	Mullet	8	4	1.1	0.42	Pond does not represent Background
PCB-123	Mullet	8	4	1.1	0.3	Pond does not represent Background
PCB-169	Mullet	7	4	0.39	0.11	Pond does not represent Background
PCB-81	Mullet	8	4	0.31	0.18	Pond represents Background
TEQ PCB	Mullet	8	4	0.13	0.046	Pond does not represent Background
PCB-118	Red Drum	4	3	7.8	11	Pond represents Background
PCB-105	Red Drum	4	3	2.1	3.3	Pond represents Background
PCB-156/157	Red Drum	4	3	1.3	1.5	Pond represents Background
PCB-167	Red Drum	4	3	0.68	0.59	Pond represents Background
PCB-189	Red Drum	4	3	0.1	0.055	Pond represents Background
PCB-77	Red Drum	4	3	0.15	0.17	Pond represents Background
PCB-114	Red Drum	4	3	0.18	0.27	Pond represents Background
PCB-126	Red Drum	4	3	0.2	0.17	Pond represents Background
PCB-123	Red Drum	4	3	0.15	0.19	Pond represents Background
PCB-169	Red Drum	4	3	0.21	0.13	Pond represents Background
PCB-81	Red Drum	4	3	0.12	0.093	Pond represents Background
TEQ PCB	Red Drum	4	3	0.027	0.021	Pond represents Background
PCB-118	Black Drum	3	1	6.3	7.5	Pond represents Background
PCB-105	Black Drum	3	1	1.5	2.9	Pond represents Background
PCB-156/157	Black Drum	3	1	0.81	0.49	Pond represents Background
PCB-167	Black Drum	3	1	0.63	0.33	Pond represents Background
PCB-189	Black Drum	3	1	0.089	0.067	Pond represents Background
PCB-77	Black Drum	3	1	0.26	0.5	Pond represents Background
PCB-114	Black Drum	3	1	0.16	0.17	Pond represents Background
PCB-126	Black Drum	3	1	0.2	0.17	Pond represents Background
PCB-123	Black Drum	3	1	0.15	0.13	Pond represents Background
PCB-169	Black Drum	3	1	0.28	0.17	Pond represents Background
PCB-81	Black Drum	3	1	0.23	0.16	Pond represents Background
TEQ PCB	Black Drum	3	1	0.026	0.022	Pond represents Background

Table 3 Lipid and Length Normalized Comparison						
Parameter	Species	Pond Sample Size	Reference Sample Size	Maximum Pond Concentration (ng/kg)	Average Reference Concentration (ng/kg)	Region 4 Comparison
PCB-118	Mullet	8	4	17	2.4	Pond does not represent Background
PCB-105	Mullet	8	4	3.5	0.66	Pond does not represent Background
PCB-156/157	Mullet	7	4	1.9	0.25	Pond does not represent Background
PCB-167	Mullet	7	4	1.4	0.16	Pond does not represent Background
PCB-169	Mullet	8	4	0.11	0.024	Pond does not represent Background
PCB-126	Mullet	8	4	0.19	0.1	Pond represents Background
PCB-114	Mullet	8	4	0.22	0.07	Pond does not represent Background
PCB-81	Mullet	8	4	0.098	0.043	Pond does not represent Background
PCB-123	Mullet	8	4	0.18	0.066	Pond does not represent Background
PCB-77	Mullet	8	4	0.32	0.09	Pond does not represent Background
PCB-189	Mullet	7	4	0.29	0.019	Pond does not represent Background
TEQ PCB	Mullet	8	4	0.023	0.011	Pond does not represent Background
PCB-118	Red Drum	3	2	15	3.9	Pond does not represent Background
PCB-105	Red Drum	3	2	3.5	1.2	Pond does not represent Background
PCB-156/157	Red Drum	3	2	1.7	0.25	Pond does not represent Background
PCB-167	Red Drum	3	2	0.99	0.26	Pond does not represent Background
PCB-169	Red Drum	3	3	0.56	0.16	Pond does not represent Background
PCB-126	Red Drum	3	3	0.51	0.19	Pond does not represent Background
PCB-114	Red Drum	3	2	0.43	0.16	Pond does not represent Background
PCB-81	Red Drum	3	3	0.29	0.11	Pond does not represent Background
PCB-123	Red Drum	3	2	0.38	0.15	Pond does not represent Background
PCB-77	Red Drum	3	3	0.35	0.2	Pond represents Background
PCB-189	Red Drum	3	3	0.27	0.066	Pond does not represent Background
TEQ PCB	Red Drum	3	3	0.069	0.025	Pond does not represent Background
PCB-118	Black Drum	3	1	11	8.2	Pond represents Background
PCB-105	Black Drum	3	1	2.8	3.1	Pond represents Background
PCB-156/157	Black Drum	3	1	1.5	0.53	Pond does not represent Background
PCB-167	Black Drum	3	1	1.1	0.36	Pond does not represent Background
PCB-169	Black Drum	3	1	0.59	0.18	Pond does not represent Background
PCB-126	Black Drum	3	1	0.38	0.19	Pond does not represent Background
PCB-114	Black Drum	3	1	0.3	0.19	Pond represents Background
PCB-81	Black Drum	3	1	0.43	0.18	Pond does not represent Background
PCB-123	Black Drum	3	1	0.28	0.14	Pond does not represent Background
PCB-77	Black Drum	2	0	0.27	NA	NA
PCB-189	Black Drum	3	1	0.17	0.074	Pond does not represent Background
TEQ PCB	Black Drum	3	1	0.05	0.025	Pond does not represent Background

NA = Not applicable